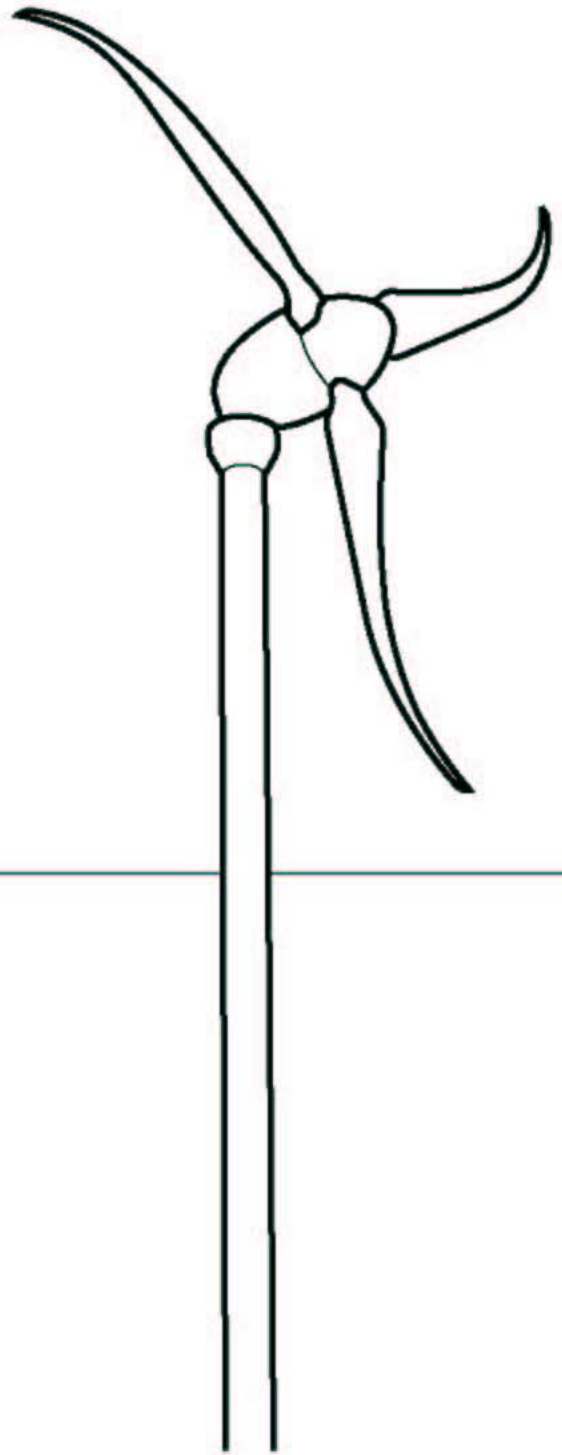


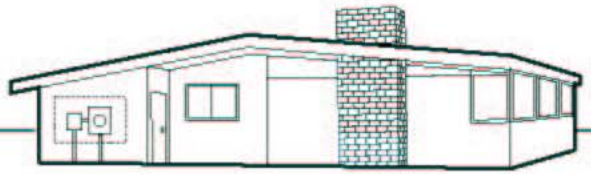
# SKYSTREAM 3.7™

## OWNER'S MANUAL

**Installation**

**Operation**

**Maintenance**



Southwest Windpower, Inc.
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**www.skystreamenergy.com**

MADE IN THE USA

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**Renewable Energy**
**Production Solutions**
Bockholm, 21760 Houtskär
www.reps.fi, +358-40-5883344

## Southwest Windpower

**Congratulations on your purchase and welcome to our family!**

Dear Skystream 3.7™ Owner,

Thank you for your purchase of Skystream. You have just selected the most technologically advanced, cost-effective renewable energy appliance available for a home or small business. We congratulate you on your choice and are confident you will experience years of dependable service.

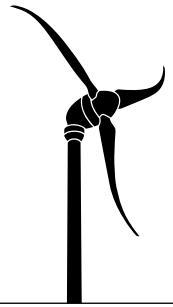
Before going any further, please complete and return the enclosed Warranty Registration Card. **The conditions of your warranty are dependent upon the proper installation of Skystream.** Furthermore, this will assure you of being kept up-to-date with the latest developments from Southwest Windpower. These include new options, performance tips, updated software to maximize output and user notices. It is important to know that we do not sell or distribute your information to any third party. We understand your privacy is important.

If you have any questions or comments, we would like to hear from you. Please call during working hours (Monday-Friday – 8:00 am to 5:00 pm Mountain Standard Time). Our number is **928-779-9463,** toll-free **866-807-9463.**

Again, welcome to our family and thank you for investing in the future of wind energy with Skystream.

Best Regards,

Southwest Windpower



**Enter the serial and model number below**

Serial Number _____

Model Number _____

Skystream Installation Manual
Document No. 0313
Revision: F

## IMPORTANT SAFETY INSTRUCTIONS

**READ THESE INSTRUCTIONS IN THEIR ENTIRETY BEFORE INSTALLING OR OPERATING.**

**Professional installation**
highly recommended

**1)** SAVE THESE INSTRUCTIONS. This manual contains important instructions for Skystream that must be followed during installation and maintenance.

**2)** Read, understand and respect all warnings.

**3)** Do not install Skystream around standing water.

**4)** Do not install Skystream on a windy day.

**5)** Install Skystream in accordance with National Electric Code (NEC) and local building codes.

**6)** Always obtain a building permit before construction.

**7)** When moving Skystream or any heavy objects to the site, use a cart to prevent back injury.

**8)** If unusual noise or abnormal operation is observed from Skystream, turn off the machine and contact authorized service personnel.

**9)** This wind generator complies with international safety standards and therefore the design or its installation must never be compromised.

- a. Do not open the inverter cover, doing so without factory authorization will void the warranty.
- b. Apply the proper torque to all fasteners.
- c. Torque field wire connections to Skystream to 20-25 inch-lbs. (2.3-2.5 N-m). Refer to Electrical Connections section of this manual (Section 2-1-2).
- d. Install only on a Professional Engineer (PE) certified tower.
- e. Do not paint the blades.

**10)** Use only proper grounding techniques as established by the NEC.

**11)** Properly complete the warranty registration card; failure to complete and return the card may affect your warranty.

**12)** Skystream must be installed in accordance with this manual and local and national building codes. Failure to comply with the manual and local codes will affect and possibly void your warranty.

**13)** Skystream uses high voltage and is potentially dangerous. Be sure to use all safety precautions at all times.

### In this manual

**IMPORTANT:**
Please take note

**TIP:** Helpful information to ease the installation

**Professional installation**
highly recommended

**Warning:** Risk of injury or death - proceed with extreme caution

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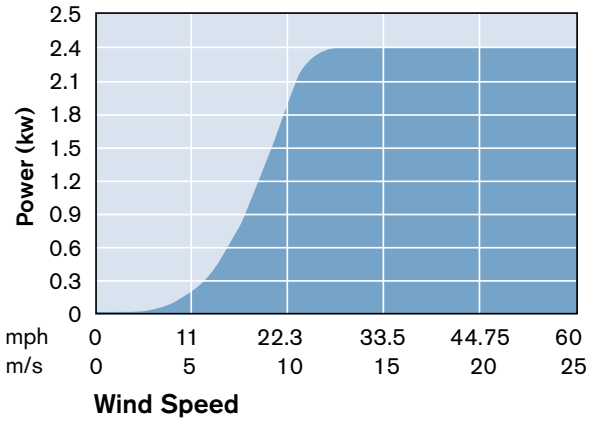
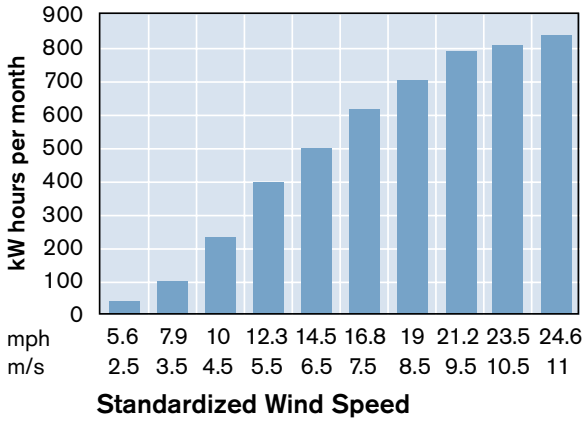
## Skystream 3.7™ Technical Specifications

| | |
|---|---|
| **Model** | Skystream 3.7 |
| **Rated Capacity** | 1.8 kW rated 2.4 kW peak |
| **Weight** | 170 lbs. / 77 kg |
| **Rotor Diameter** | 12 feet / 3.72 meters |
| **Swept Area** | 115.7 $ft^2$ / 10.87 $m^2$ |
| **Type** | Downwind rotor with stall regulation control |
| **Direction of Rotation** | Clockwise looking upwind |
| **Blades** | 3 Fiberglass reinforced composite |
| **Rated Speed** | 50 - 325 rpm |
| **Tip Speed** | 66 - 213 f/s / 9.7 - 63 m/s |
| **Alternator** | Slotless permanent magnet brushless |
| **Yaw Control** | Passive |
| **Grid Feeding** | Southwest Windpower Utility Interactive 120/240 VAC 50-60 Hz and 120/208 VAC, 60 Hz, 3 Ph. |
| **Braking System** | Electronic stall regulation w/redundant relay switch control |
| **Cut-in Wind Speed** | 8 mph / 3.5 m/s |
| **Rated Wind Speed** | 20 mph / 9 m/s |
| **User Control** | Wireless 2 way interface remote system |
| **Survival Wind Speed** | 140 mph / 63 m/s |
| **Total Harmonic Distortion** | 2.7% at 2400W, meets UL1741 and IEEE1547.1requirements. |
| **Frequency Accuracy** | +/- 0.02 Hz |
| **Voltage Accuracy** | +/- 2.0 V (line to neutral) |
| **Surge Rating** | IEEE 1547 Surge Rating B |

**PERFORMANCE GRAPH**




**ENERGY CHART**



## Skystream 3.7™ Technical Specifications (continued)

**Voltage and Frequency Trip Points**

| Condition | Value | Units | Trip Time (sec) |
|---|---|---|---|
| **Voltage stop minimum** | 105.6 | volts | 1.5 |
| **Voltage stop maximum** | 132 | volts | 0.75 |
| **Voltage fast stop minimum** | 60 | volts | 0.117 |
| **Voltage fast stop maximum** | 144 | volts | 0.117 |
| **Voltage start minimum** | 106.6 | volts | – |
| **Voltage start maximum** | 127 | volts | – |
| **Frequency stop minimum** | 59.3 | Hz | 0.1 |
| **Frequency stop maximum** | 60.5 | Hz | 0.1 |
| **Frequency start minimum** | 59.4 | Hz | – |
| **Frequency start maximum** | 60.4 | Hz | – |
| **Minimum Start Time after grid fault** | 300 | seconds | – |

**Tower Data (Loads calculated at 145 mph - 65 m/s)**

| | | |
|---|---|---|
| **Shaft Thrust** | 2802<br>630 | N<br>lbs |
| **Downward** | 932<br>210 | N<br>lbs |
| **Bending Moment** | 1532<br>1130 | N.M.<br>ft-lb |

## One - Before Installation

Instructions in this guide apply to the following Skystream Land and Marine models:

- 120/240VAC, 60Hz
- 120/208VAC, 60Hz
- 230VAC, 50Hz
- 120VAC, 60Hz

Please specify “land” or “marine” and voltage and frequency when ordering parts or requesting service as components differ.

### 1-1 Package Contents

Before you begin, inspect the contents to make sure there is no damage or missing parts.

- Identify the parts of your Skystream system using the information on the next two pages.
- Inspect for damage and/or missing parts.

Your Skystream wind generator is shipped in two boxes:

**Box One: rotor blades (three each)**

- Box dimensions: 76”L x 15”W x 12”H (102 cm L x 56 cm W x 69 cm H)
- Weight: 40 lbs (18 kg)

Upon opening, carefully inspect each of the blades to make sure there are no fractures or cracks in the surfaces. Although the Skystream rotor blades are comprised of a durable compression molded fiberglass, damage can occur to the blades during shipping. Once inspected, be sure to set them away from the construction site and protect them from any damage until they are ready for assembly.

**Box Two: Skystream 3.7 wind generator assembly**

- Box dimensions:  40”L x 22”W x 27”H (102 cm L x 56 cm W x 69 cm H)
- Weight: 175 lbs (80 kg)

Your Skystream comes in several versions in accordance with local utility requirements. Be sure to inspect the package and confirm you have the right voltage and frequency. If you have ANY questions, call your dealer or the factory before continuing.

**Your Skystream shipment includes:**

Your Skystream shipment includes the following components. A spare of each fastener (bolt, washer or nut) is included. The quantities indicated below are quantities required to assemble Skystream:

RF Antenna

Loctite® 242

Turbine assembly with blade hub, retaining nut, blade plate and nosecone

Blades and blade mounting hardware
- M10-1.5 x 120 socket head bolts, grade 12.9 (quantity 12)*
- M10-1.5 nuts, grade 12.9 (quantity 12)
- M10 flat washers, A2 stainless steel (quantity 12)
- M10 lock washer, A2 stainless steel (quantity 12)
- Blade plate
- Blade hub
- M42, hub nut

Nose cone with mounting hardware
- M6-1.0 x 12 socket head bolts, grade 8.8 (quantity 3)

*Three blade bolts are shipped on blade hub, not in bolt kit bag.

Yaw vibration isolators with mounting hardware
- Vibration Isolators (quantity 8)
- M12-1.75 x 90 hex head bolt, grade 10.9 (quantity 8)
- M12-1.75 nuts, grade 10.9 (quantity 8)
- M12 flat washers, A2 stainless steel (quantity 8)
- M12 lock washers, A2 stainless steel (quantity 8)
- M12 snubbing washers (quantity 8)

Yaw shield (two halves) with mounting hardware
- M5-0.8x12 button head screws (quantity 4)

Strain relief cover assembly with mounting hardware
- Strain relief cover with ground wire
- M5-0.8 x 12 socket head bolt (quantity 4)
- M5 lock washer A2 stainless steel (quantity 4)

**TIP:** See exploded view on pages 26-27

**1-2 Recommended Tools**

You will need the following tools to complete assembly of Skystream and install on the tower:

- 17 and 19 mm combination wrenches
- 19 mm socket for torque wrench
- Wire stripper, cutter
- Phillips head screwdriver
- Flat blade screwdriver socket for torque wrench
- Multi-meter
- Torque wrench, 0-100 lb-ft (135 N-m)
- Torque wrench, 0-50 lb-inch ( 5.6 N-m)
- 8 mm “allen” socket for torque wrench
- 3, 4, 5 & 8 mm allen wrenches

**Note:** This list does not include tools you will need for the construction of the tower or wire trench.

### 1-3 Skystream Options

There are a number of options that can enhance the experience of using a Skystream wind appliance. Although your Skystream will operate without them, we suggest reviewing this chapter. Contact Southwest Windpower or your dealer if you have questions.

| | |
|---|---|
| | **Wireless Remote Display**<br>The optional remote display allows you to observe Skystream's performance in real time. You can also collect data such as KWh per day, per month and per year. The display wirelessly connects via a 900 MHz frequency and works up to 1000 feet (305 m). Actual range may depend on local conditions.<br><br>**Remote Monitoring**<br>There are a number of benefits to remote monitoring. A subscription to Fat Spaniel Technology allows a third party company to monitor the performance of your Skystream and communicate with a local dealer in the event there is a problem. Additionally, for states with "green tags" you could receive added revenue for each KWh your Skystream produces. Contact your dealer or Southwest Windpower directly for more information. |
| | **USB Converter & DataLogger Software**<br>The USB converter allows you to connect the remote display to your computer and monitor Skystream real time. Specialized software allows you to create your own power curves, monitor performance remotely and even download and transmit the latest software directly to your Skystream to maximize performance. To connect Skystream to your computer, you must also use the wireless remote. |
| | **Battery Voltage Sensor**<br>The battery voltage sensor enables use of Skystream with battery based or battery backed systems. Sensor monitors battery voltage and sends charging information to Skystream by rapid frequency. |
| | **Tower Adaptor**<br>The tower adaptor allows you to attach your Skystream to a tower constructed of 5 inch schedule 40 pipe. Nominal internal diameter of 5 inch (12.7 cm). |

Images shown are not to scale.

### 1-4 Skystream Project Preparation

There are several considerations before you begin the installation process of your Skystream. These considerations are more important if you intend to connect your machine to the electrical utility. Although Skystream is UL 1741and IEEE 1547 certified, your local utility and zoning authority may require additional information prior to installation. This chapter will provide an overview of what to expect when working with your zoning authority and utility. Southwest Windpower has a number of resources that may assist you in the permitting and interconnection processes.

To learn more go to: www.skystreamenergy.com

#### 1-4-1 Finding the Best Location for Your Skystream

We have worked at simplifying the installation process of Skystream, but each installation is likely to be different. Skystream may require a different tower depending on trees, obstructions and soil types.

**VERY IMPORTANT:** Proper siting is essential to a well performing wind generator.

The taller the tower, the more energy your Skystream will produce. But keep in mind, this will also increase the cost of the installation. It is extremely important to balance performance (tower height) to installed cost in order for you to achieve the lowest cost of energy and quickest payback. Also, keep in mind zoning regulations that may restrict the height of your tower. See section 1-4-4 regarding zoning.

**Our General Rule:** For optimal performance, Skystream should be 20 feet (7 m) above any surrounding object within a 250 foot (76 m) radius.

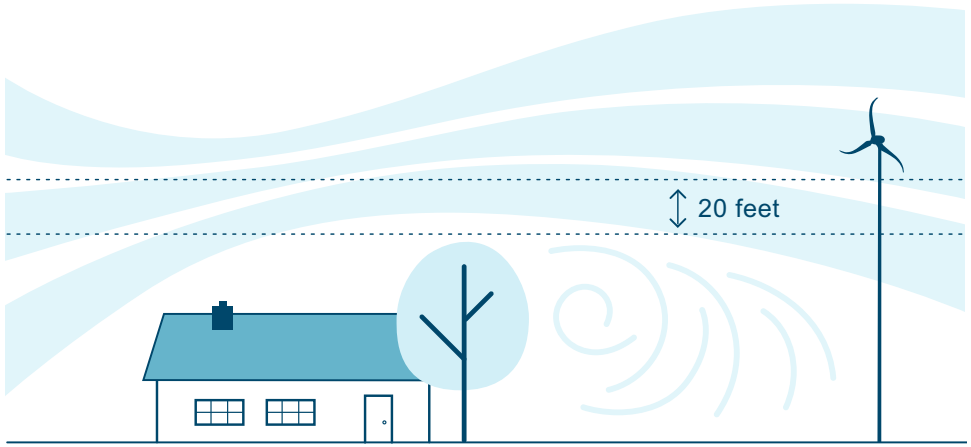



Fig. 1 Optimal Skystream location.

**TIP:** Your dealer can help you determine the best location for Skystream on your property.

### 1-4-2 Tower Types

Depending on your site needs, Skystream can be mounted on several different tower types as long as they meet the tower load specifications determined by Southwest Windpower and are certified by a Professional Engineer (PE). While a guyless monopole tower is the most desired tower type, it may be more expensive than some other options such as a guyed tower or latticed tower. You can find out more about available tower options provided by Southwest Windpower in Appendix C and at www.skystreamenergy.com.

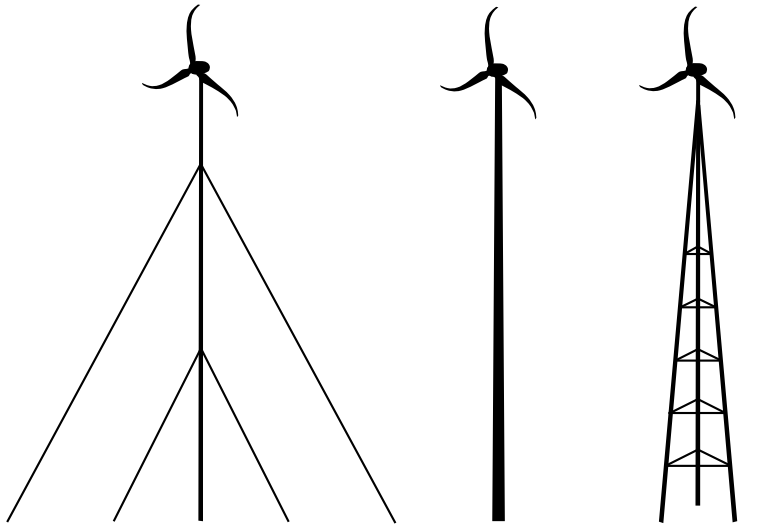



Fig. 2 Tower types

### 1-4-3 Working With Your Utility

Call your local electric utility, tell them your intentions and ask for their "Interconnection Agreement". They should have one. Depending on your utility, the interconnection agreement may be one page or many. Keep in mind that small utility-connected solar and wind systems are relatively new industries and utility connection requests may be unfamiliar to them. If you are the first, realize the process may take longer. Southwest Windpower has people and tools that may assist in the process.

Your utility may request documentation demonstrating that Skystream is UL 1741 and IEEE 1547 certified. You can download the UL Certificate of Compliance at our website: www.skystreamenergy.com

**TIP:** See our website: www.skystreamenergy.com for a sample interconnection agreement that may be used by a utility that has yet to establish a program.

### 1-4-4 Working With Your Local Zoning Authority

Like your utility, the local planning and zoning authority may or may not have experience with an individual installing a small wind generator at their home or small business. The most important issue is the height of the tower. Prior to purchasing your Skystream tower, check for local zoning limitations. Determine what your community allows for towers and determine if the height is appropriate. Specific data and statistics that may be required by your zoning authority can be found at www.skystreamenergy.com.

## Two - Installation

Southwest Windpower designed the installation process of Skystream to be as easy as possible by minimizing the number of connections between the machine and circuit breaker. Depending on your local utility requirement, you may or may not need to install a separate disconnect and/or second meter.

You will notice the rotor shaft on Skystream is extremely difficult to turn. This is normal. As a safety precaution, the default position of Skystream is in brake mode when the inverter is disconnected from the utility-supplied power. The reason is if there is a fault in the utility line, Skystream must shut down to prevent back feeding of electricity into the line while it is being repaired.

### 2-1 Electrical

One of the most common causes of wind generator failures is a poor electrical connection. Be sure to follow the instructions and tighten all fasteners appropriately.

**IMPORTANT:** It is extremely important that the installation of your Skystream is done in accordance with local and national building codes as specified by the NEC, UBC (Uniform Building Code) or IBC (International Building Code). These codes will vary from city to city and country to country.

The AC input and AC output circuits are isolated from the enclosure. System grounding, if required by section 250 of NEC, ANSI/NFPA 70, is the responsibility of the installer.

#### 2-1-1 Wiring

Skystream has a built-in utility-connected inverter compliant with UL 1741 and IEEE 1547. This means Skystream connects directly to your existing electrical system. Appendix A includes reference drawings for utility-supplied power interconnection of your Skystream generator. These drawings are for reference and may be modified for submittal and approval by your local authorities.

Refer to **Fig. 3** on following page for an overview of a typical residential Skystream wiring installation

**Warning:** For your safety, make sure power is turned off before working on any and all electrical connections.

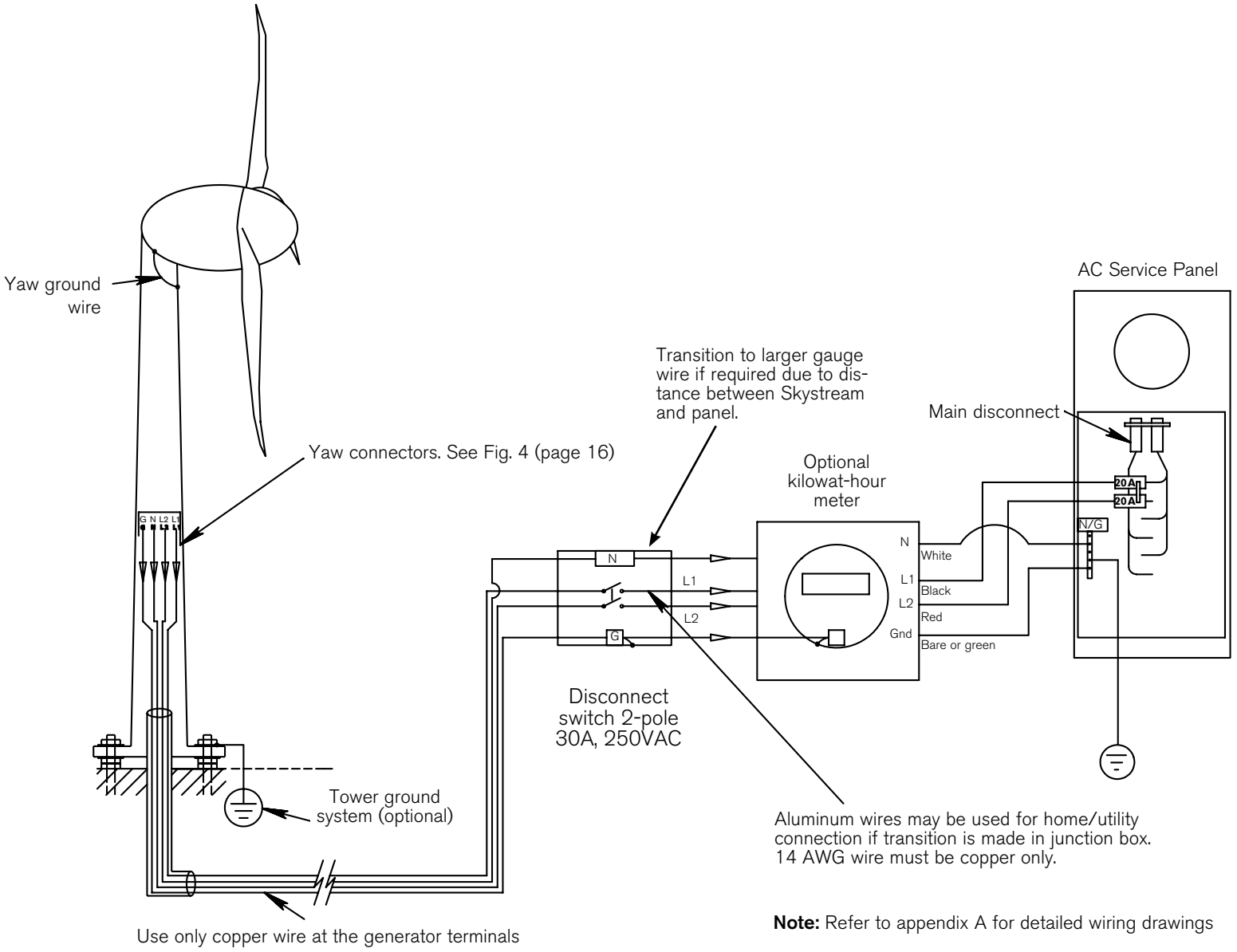



Fig. 3 Wiring diagram, 240V, 60Hz, split phase.

### 2-1-2 Electrical Connections

**CAUTION – Be sure power is turned off when making electrical connections.**

- Position Skystream on its side to access the wire terminals.
- Remove approximately 2 inches (5 cm) of protective sheathing from cable and strip approximately 0.375 inches (1 cm) of insulation off wire leads.
- Note the maximum wire size that can be connected directly to Skystream is #8 AWG. Refer to Wire Sizing Section of this manual for instructions on selecting correct size wire.
- Pass cable through strain relief cover so approximately 1 inch (2.5 cm) of cable sheath protrudes through as shown in **Fig. 4a**. Tighten strain relief clamp to secure cable.
- **120/240 V, 60 Hz, Split Phase and 120/208 V, 60 Hz, 3 Phase systems:** Connect the red, black and white wires to the corresponding color coded terminals on Skystream yaw. Connect green or bare copper wire to the green terminal. Tighten wire terminal screws to 20-25 inch-lbs (2.3-2.5 N-m). See **Fig. 4a**.
- **230 V, 50 Hz, 1 Phase systems:** Connect the brown, blue and green/yellow wires to the matching corresponding color coded terminals on Skystream yaw. There is no wire connection to bare yaw terminal as shown in Fig 4b. Tighten wire terminal screws to 20-25 inch-lbs (2.3-2.5 N-m).

**Caution:** Make sure AC power is switched "OFF" before proceeding with installation.

- **120 V, 60 Hz, 1 Phase Systems:** Connect the black and white wires to the corresponding color coded terminals on the Skystream yaw. Connect green or bare copper wire to green terminal. There is no wire connection to bare yaw terminal as shown in **Fig. 4c**.

Before attaching the strain relief cover, test the electrical connections by turning on power and measuring voltage at the yaw terminals. Additionally, with AC power switched on, wait 5-7 minutes and attempt to rotate the blade shaft. The shaft should be noticeably easier to rotate. Turn* off power and Skystream should revert to "brake" mode. If Skystream fails this test, check all connections and repeat test. Test must be passed before proceeding.

- Turn power off and secure strain relief cover using four M5-0.8 x 12 socket head screws and split lockwashers. Use Loctite® 242 and torque screws to 20-25 inch-lbs (2.5 N-m).

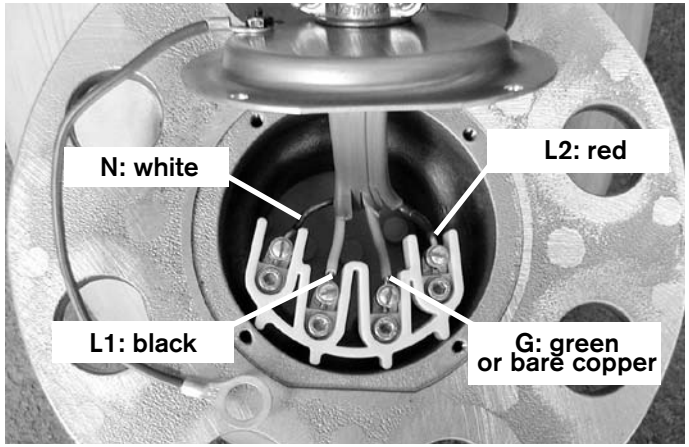



Fig. 4a Wire run to the yaw connection (120/240 V, 60Hz, Split Ph and 120/208V, 60 Hz, 3 Ph).

**Wiring Symbol Definitions - 120/240 V, 60 Hz, Split Phase and 120/208 V, 60 Hz, 3 Phase**

L1 = Line 1, AC Line Voltage, Black Wire (240V, 60 Hz, systems)
L2 = Line 2, AC Line Voltage, Red Wire (240V, 60 Hz, systems)
N = AC Neutral, White Wire, (240V, 60 Hz, systems)
G = Gnd. = AC Ground, Green or Bare Wire
⏚ Indicates AC Ground

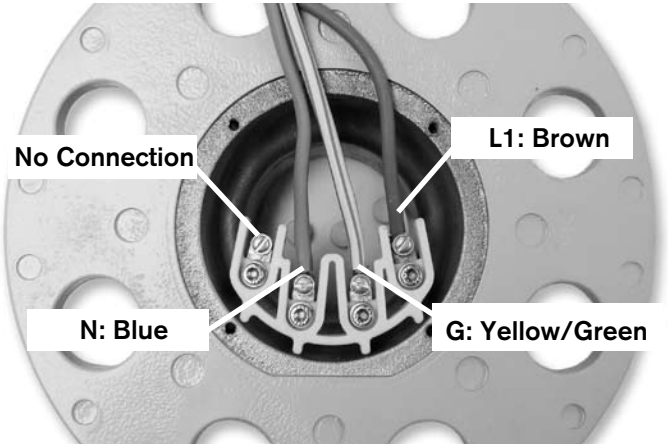



Fig. 4b Wire run to the yaw connection (230V, 50Hz, single phase).

**Wiring Symbol Definitions - 230 V, 50 Hz, Single Phase Systems**

L1 = Line 1, AC Line Voltage, Brown Wire (230V, 50 Hz, systems)
N = AC Neutral, Blue Wire, (230V, 50 Hz, systems)
G = Gnd. = AC Ground, Green/Yellow Wire
⏚ Indicates AC Ground

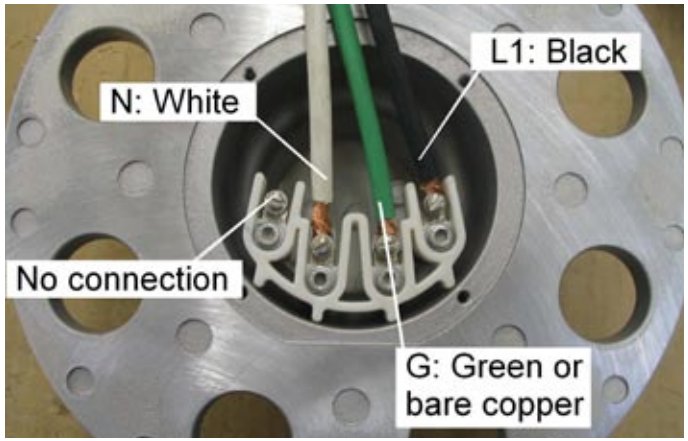



Fig. 4c Wire run to the yaw connection (120 V, 60 Hz, single phase).

**Wiring Symbol Definitions - 120 V, 60 Hz, Single Phase Systems**

L1 = Line 1, AC Line Voltage, Black Wire
N = AC Neutral, White Wire
G = AC Ground, Green or Bare Wire
⏚ Indicates AC Ground

### 2-1-3 Wire Sizing

Measure distance from AC Service panel to Skystream including tower height. Refer to the Wire Size Table and based on system voltage and measured distance determine appropriate wire size.

The maximum wire size that can be connected to Skystream yaw is 8 AWG (10mm2) therefore if a larger wire size is required because of the installed distance, Southwest Windpower recommends installing a Power Disconnect Switch box close to the base of the tower and transitioning to the appropriate size wire. Refer to **Figs. 3, 4** and **Appendix A** for detailed information.

Battery charging systems may utilize smaller gauge wire than indicated in the Wire SizeTable. Refer to diagrams in **Appendix A** for wire sizes. The smaller wires are based on allowing 4% voltage line loss for battery charging systems compared to 2% line losses indicated in the Wire Size Table.

### 2-1-4 Grounding

Every electrical system must be grounded in accordance with local and national standards. This will provide some protection against voltage surges and built-up static charges (see reference drawings in **Appendix A**).

Section 810 of the National Electrical Code ANSI/NFPA No. 70 (USA only) provides information with respect to proper grounding of the tower, size of the ground wire, type of discharge unit, size of grounding conductors, location of discharge unit, connection to grounding electrodes and requirements for the ground electrode.

**Note:** The AC output neutral is NOT bonded to ground within Skystream. AC neutral is bonded to ground at AC distribution panel.

**The instructions in this section are for reference only as the requirements in your area may be different.**

### 2-1-5 Fusing/Circuit Breaker

Skystream connects directly into your electrical panel. Wiring will vary with local zoning authority and utility. Refer to Appendix A for drawings for each voltage, frequency and phase configuration. Some installations will require a visible lockable disconnect switch located next to the electrical meter and/or at the base of the tower. The disconnect switch is utilized by your local utility in the event of a power outage to ensure no voltage is placed on the utility line during repair. Again, it is extremely important to install in accordance with local and national zoning regulations.

**Note:** Only 20 Amp circuit breakers may be used to connect Skystream to AC service panel. Refer to **Fig. 3**, wiring diagram.

| | Maximum Distance | | | |
|---|---|---|---|---|
| Wire Size | 120 V | 120/208 V | 230 V | 120/240 V |
| 4 AWG (25 mm2) | 646 ft (197 m) | 885 ft (270 m) | 934 ft (285 m) | 1017 ft (310 m) |
| 6 AWG (16 mm2) | 407 ft (124 m) | 557 ft (170 m) | 588 ft (179 m) | 640 ft (195 m) |
| 8 AWG (10 mm2) | 256 ft (78 m) | 351 ft (93.3 m) | 371 ft (113m) | 403 ft (123 m) |
| 10 AWG (6 mm2) | 161 ft (49 m) | 220 ft (67.0 m) | 232 ft (70.7m) | 253 ft (77 m) |
| 12 AWG (4 mm2) | 101 ft (31 m) | 139 ft (42.4 m) | 146 ft (44.5) | 159 ft (48.5 m) |
| 14 AWG (2.5 mm2) | 64 ft (20 m) | 87 ft (26.5 m) | 92 ft (28 m) | 100 ft (30.5 m) |

Use copper conductors only - Minimum wire temperature rating is 75° C (167°F). Distances and wire sizes are based on 1800 W power production and maximum 2% voltage line loss. Distances for 120 V system based on 3000 W power production and 8% voltage line loss.

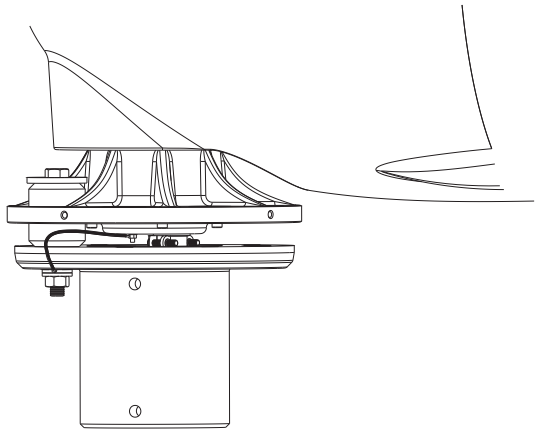


Fig. 5 Proper grounding of the yaw connection

### 2-1-6 Battery Charging

In addition to conventional grid connected systems, Skystream may be used with battery based systems or grid connected systems with battery back up. In the great majority of these applications the same Skystream is utilized as in grid connected system with the exception that a voltage sensor is required to transmit battery charge information to Skystream. This means that if in the future battery back up is no longer required or if connectivity to the grid is available the same Skystream may be utilized to supply power.

The following sections present the three most common Skystream battery charging or battery backup installation configurations. The best configuration for your particular application depends on a many factors including system type: battery based or battery backup, availability of existing equipment such as inverters, required voltage, wire run distance and of course cost.

**2-1-6-1 Option A**
**120/240 Volt Skystream, Two Inverters**

This option is a good choice for grid connected homes requiring battery backup and 240 volts. The same model Skystream is used for grid connected homes without battery backup therefore the system is adaptable if there is no longer a requirement for battery backup. The system is depicted below.

System Components:

- Skystream 3.7, Land unit part number 1-SSL-10-240, Marine unit part number 1-SSM-10-240
- Wireless Battery Voltage Sensor, part number 2-SSUP-102-02
- Wireless Display (optional), part number 2-SSUP-100-02
- Inverter (2 required), Southwest Windpower recommends Outback FX Series or Xantrex SW Series Inverters.

System Wiring

Wiring requirements for Battery Charging systems differ from Battery Backed - Grid Connected systems. Refer to **Appendix A** for specific wiring schematics.

Consult with your inverter supplier regarding inverter and battery installation. Due to the large number of inverter and battery system configurations it is not possible for Southwest Windpower to provide specific wiring instructions.

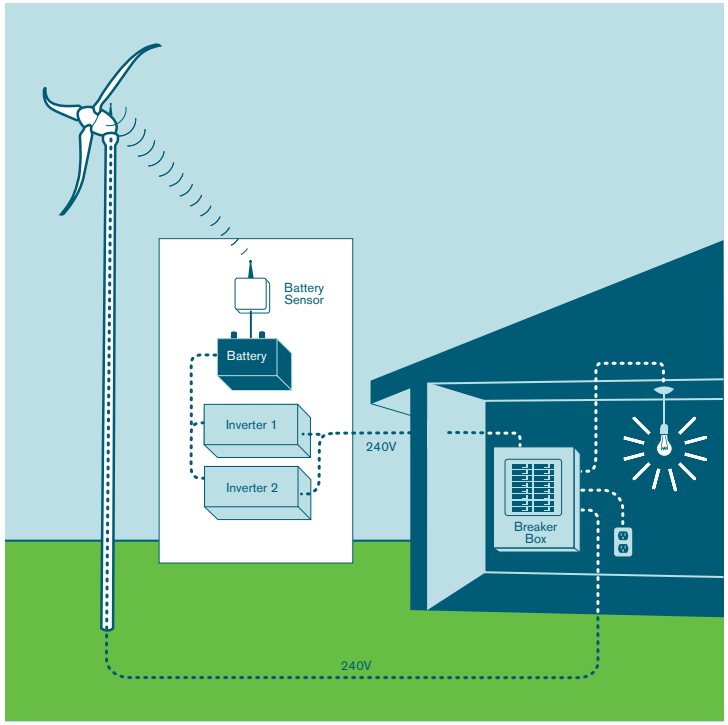



Fig. 6 Battery charging Option A

### 2-1-6-2 Option B
### 120/240 Volt Skystream with Transformer

This option is a good choice for systems with an existing inverter. It supports 240 volt loads and may be transitioned to a dedicated grid tied system if required in the future. The system differs from Option A in that a transformer takes the place of the second inverter. There is an inefficiency of approximately 20 watts associated with the transformer, however the inefficiency may be worth the reduced cost of the transformer compared to a second inverter.

Skystem Components:

- Skystream 3.7, Land unit part number 1-SSL-10-240, Marine unit part number 1-SSM-10-240
- Wireless Battery Voltage Sensor, part number 2-SSUP-102-02
- Wireless Display (optional), part number 2-SSUP-100-02
- Inverter (1 required), Southwest Windpower recommends Outback FX Series or Xantrex SW Series Inverters.
- Transformer, Southwest Windpower recommends the Outback PSX240 or Xantrex T24 transformers.

System Wiring

Wiring requirements for Battery Charging systems differ from Battery Backed - Grid Connected systems. Refer to **Appendix A** for specific wiring schematics.

Consult with your inverter supplier regarding inverter and battery installation. Due to the large number of inverter and battery system configurations it is not possible for Southwest Windpower to provide specific wiring instructions.

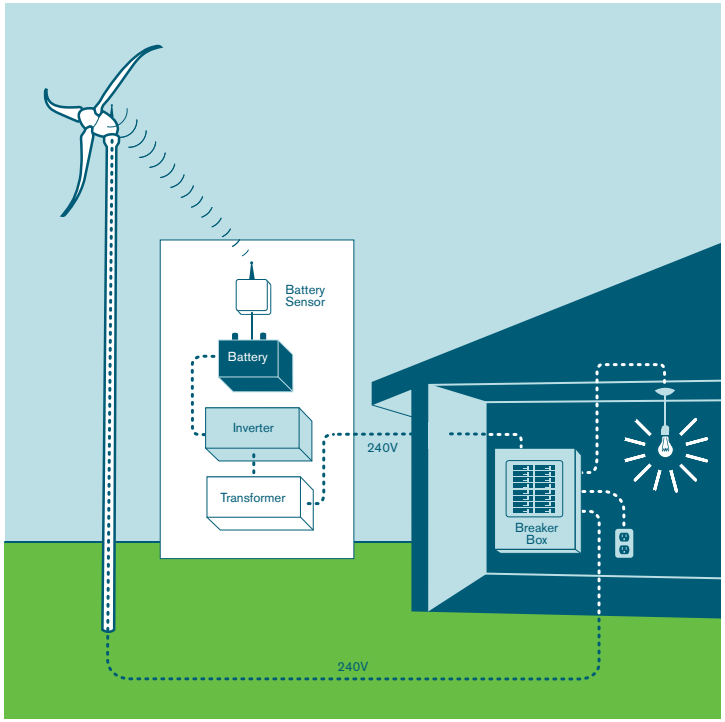



Fig. 7 Battery charging Option B

### 2-1-6-3 Option C
### 120 Volt Skystream, Single Inverter

This option is a good choice for homes that do not require 240 volt service. It is an economical system, however, it uses a different model Skystream than 240 volt systems, and therefore if conversion to 240 volt service is required in the future this system may not be a good choice.

And because this is strictly a 120 volt system if long wire runs are necessary Option B may be a more economical choice. Peak power in high winds is also reduced because this is a 120 volt system, therefore, this wind turbine may not be a good choice for high wind locations. The system is depicted below.

#### System Components

- Skystream 3.7, Land unit part number 1-SSL-10-120, Marine unit part number 1-SSM-10-120.
- Wireless Battery Voltage Sensor, part number 2-SSUP-102-02
- Wireless Display (optional), part number 2-SSUP-100-02
- Inverter (1 required), Southwest Windpower recommends Outback FX Series or Xantrex SW Series Inverters.

#### System Wiring

Wiring requirements for Battery Charging systems differ from Battery Backed - Grid Connected systems. Refer to **Appendix A** for specific wiring schematics.

Consult with your inverter supplier regarding inverter and battery installation. Due to the large number of inverter and battery system configurations it is not possible for Southwest Windpower to provide specific wiring instructions.

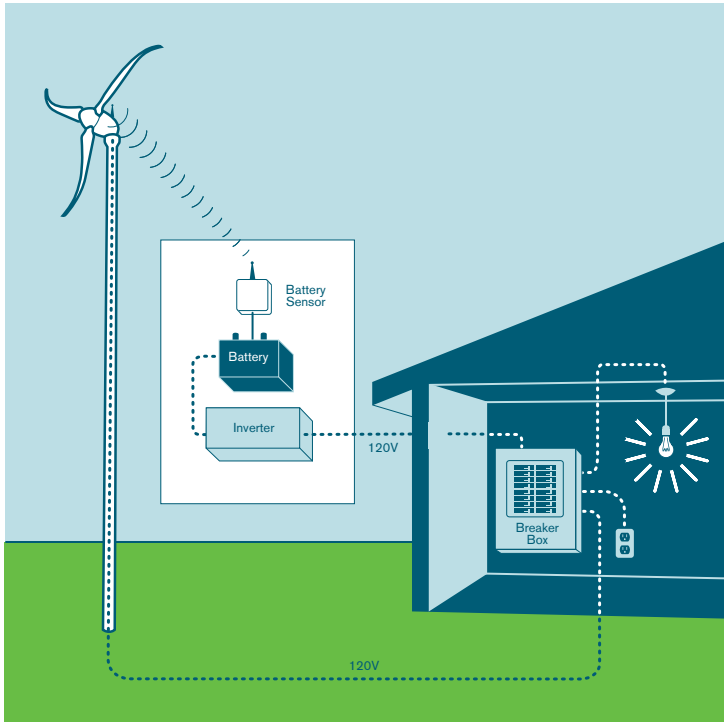


Fig. 8 Battery charging Option C

### 2-1-7 Battery Voltage Sensor Installation

The Battery Voltage Sensor is shown at the right. Customer is required to supply two battery connection terminals and color coded wire.

Install sensor as follows:

- The battery voltage sensor connector will accept #20 to #14 AWG wire. Use largest gauge wire compatible with battery connection terminals. Follow good practice and color code wires – red for positive, black for negative is typical.
- Determine sensor mounting location, maximum recommended wire length is 150 ft and 30 ft for #14 and #20 AWG wire respectively.
- Strip approximately 1/4" of insulation from wires and insert in green connector supplied with Battery Voltage Sensor. Tighten screws to secure wires. Correct wire locations (battery + and -) are indicated on Battery Voltage Sensor cover. Refer to **Fig. 9**.
- Strip insulation from other end of wires ends and install battery connection terminals following manufacturer's recommended procedure. Connect battery connection terminals to batteries.
- Insert green connector into Battery Voltage Sensor.

The sensor is now powered and ready for configuration with your system. Refer to **Appendix D**, or Interface and Software (Wireless Remote Display, USB & DataLogger Software) Manual for specific setup instructions. Do not leave sensor connected to batteries without configuring sensor and Skystream for battery charging.

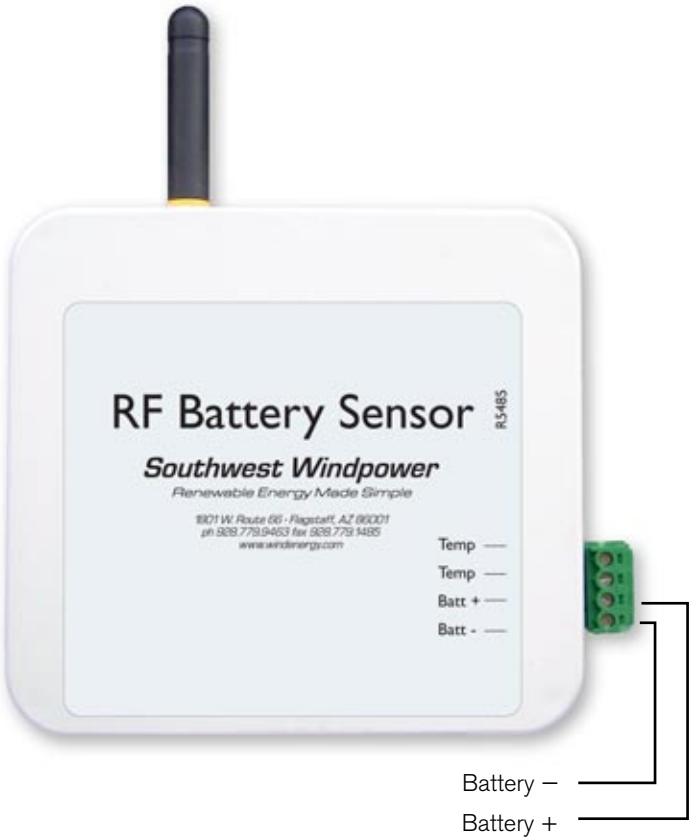



Fig. 9 Battery Sensor

**IMPORTANT:** Battery voltage sensor and Skystream must be configured for battery charging or serious damage to batteries may result.

### 2-2 Installing Skystream on a Tower

There are several types of towers that can be used with Skystream. It is essential that Skystream is installed on a properly engineered tower. One of the leading causes of wind generator failure is use on a poorly designed tower.

Southwest Windpower has made available various tower designs that meet our criteria. We have established a program allowing tower manufacturers to include their designs on Southwest Windpower's website list of recommended towers.

Regardless of the tower design and height you select, there are two critical areas that must be considered when selecting the tower. These are the stub tower height and blade clearance (**see Fig. 10**).

**IMPORTANT:** Southwest Windpower's Warranty is only extended to installations that are made on a properly engineered tower. Southwest Windpower reserves the right to deny any warranty claim in which an improperly designed tower is used**.**

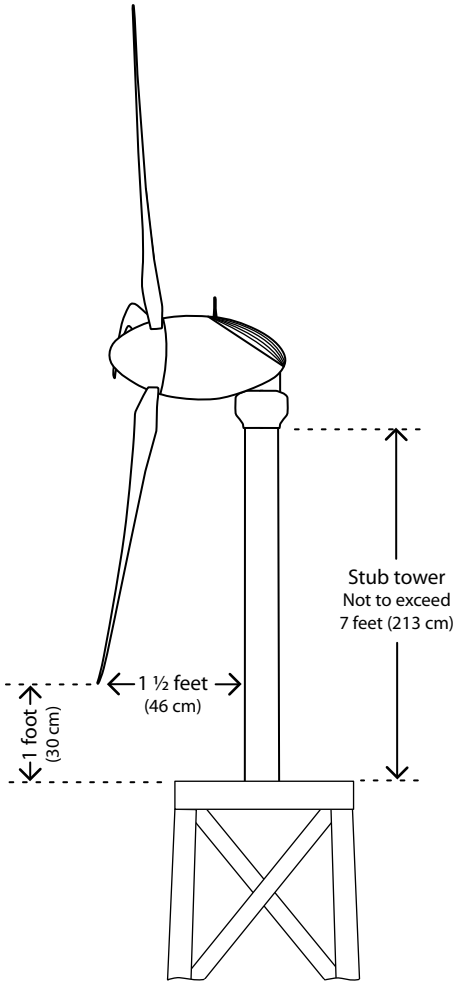



Fig. 10 Blade tip clearances

### 2-2-1 Mounting Skystream to the Tower

Refer to **Figs. 9-15** for visual aid.

**Note:** The following directions assume Skystream will be bolted to the tower on the ground and the tower tilted into position as in the case of the 33 Ft. tower. Alternately, Skystream may be hoisted to tower top using a crane in the case of larger towers that cannot be tilted into position. Instructions for hoisting Skystream are given below.

**Warning:** Working on towers is dangerous and should be left to professionals with proper safety equipment and training.

To ease mounting Skystream, support the upper end of the tower approximately 2-3 feet (0.6-1.0 m) above the ground.

- Install the vibration isolators on yaw flange as shown in **Fig. 11** (also see **Fig. 15**, page 26). Install snubbing washers and bolts in vibration isolators.

**Note:** The orientation of the vibration isolators is very important. Refer to **Fig. 15** (page 26).

- Using an appropriate lifting device and sling, lift Skystream and align vibration isolator bolts with holes in tower flange.
- Install nuts, flat washers and lock washer on bolts to secure Skystream to tower.
- Torque vibration isolator bolts to 80 lb-ft (108 N-m) in two steps. First torque all bolts to 40 lb-ft (54 N-m) then to 80 lb-ft (108 N-m).
- Mount yaw shield halves using four M5 button head screws. See **Fig. 15** (page 26). Use Loctite® 242 supplied with Skystream.

**Note:** If you are using a tower that is not a tilt-up design, then the Skystream can be hoisted to the top of the tower.

- You will need a crane, or equivalent device, capable of hoisting 170 lbs (77 kg), and be able to reach the tower-top.
- The assembled Skystream can be hoisted to the top of the tower using a large width nylon strap. The nylon strap should be secured around the nacelle and cinched tight prior to hoisting.
- The Skystream can be hoisted with the rotor blades and hub already attached.
- The location of this strap is midway between the rotor blades and yaw, at the approximate balance point on the Skystream assembly. Do not stand under the Skystream while it is being raised.

### 2-3 Testing on the Ground

Though Skystream is thoroughly tested at the factory, it is very important to conduct one more test prior to erecting the tower. Skystream should be wired and mounted to the top of the tower. The blades should not be attached. To do this test, you must have all wires and breakers installed with at least one disconnect switch open (off).

### 2-3-1 Electrical Test

- Attempt to rotate the rotor shaft. It should be difficult to turn.
- Now turn on all power going to Skystream. Turn on all breakers, connect all switches and wait 5-7 minutes.
- Grab the rotor shaft again and try to spin it. If assembled correctly, it should spin easily.
- Before you go any further, turn the power off and disconnect any switches. Again, try spinning the shaft. It should be difficult to turn.

If Skystream does not spin freely after electrtical test, then check for loose or disconnected wires. Repeat the test until you are successful.

Fig. 11 Placing vibration isolators

Fig. 12 Tightening Bolts

Fig. 13 Tightening Bolts

Fig. 14 Ready to attach yaw shield

### 2-4 Blades, Nosecone and Antenna Assembly

Refer to **Fig. 16** (page 27) for visual aid.

The Skystream blades may be bolted to the blade hub and mounted on Skystream as a complete assembly by performing the following steps.

- Remove the blade mounting hub and plate from Skystream by "unscrewing" the hub while holding the rotor shaft stationary.
- Place a blade between the blade hub and blade mounting plate. Refer to **Fig. 16** (page 27) for proper orientation.
  **Note:** the blades may only be installed in one position due to the "triangular" boss cast into one side of the blade root (base).
- Loosely install the bolts, flat and lock washers for one blade leaving enough play so remaining blades can be installed.
- After all blades and bolts are loosely installed between blade hub and mounting plate, tighten bolts enough to clamp blades between hub and blade plate.
- Torque blade bolts to 50 lb-ft (68 N-m) in two steps. First torque all bolts to 25 lb-ft (34 N-m) then to 50 lb-ft (68 N-m).
- Blade assembly may now be mounted on Skystream. Slide blade assembly completely onto shaft. With assembly completely on shaft, large mounting nut can be started on shaft threads.
- Completely "spin" on blade assembly. Securely tighten blade assembly by holding blades and tightening "flat" on rotor shaft.
  **Note:** the blade assembly is self-tightening in operation; however it should be securely tightened during assembly (200lb-ft).
- Install nosecone with three M6-1.0x12 socket head bolts. Use Loctite® 242 supplied with Skystream.
- Install RF Antenna on matching fitting on top of Skystream. Finger-tight is sufficient.

**Important: Do Not Forget to install RF Antenna**

Even if you have not purchased the optional remote display, the RF antenna may be used by service personnel to diagnose, troubleshoot or upgrade your Skystream without removing it from the tower.

**IMPORTANT:** Liberally lubricate blade and vibration mounting nuts and bolts with oil. Fasteners have extra plating to prevent corrosion and lubrication will ease assembly and disassembly.

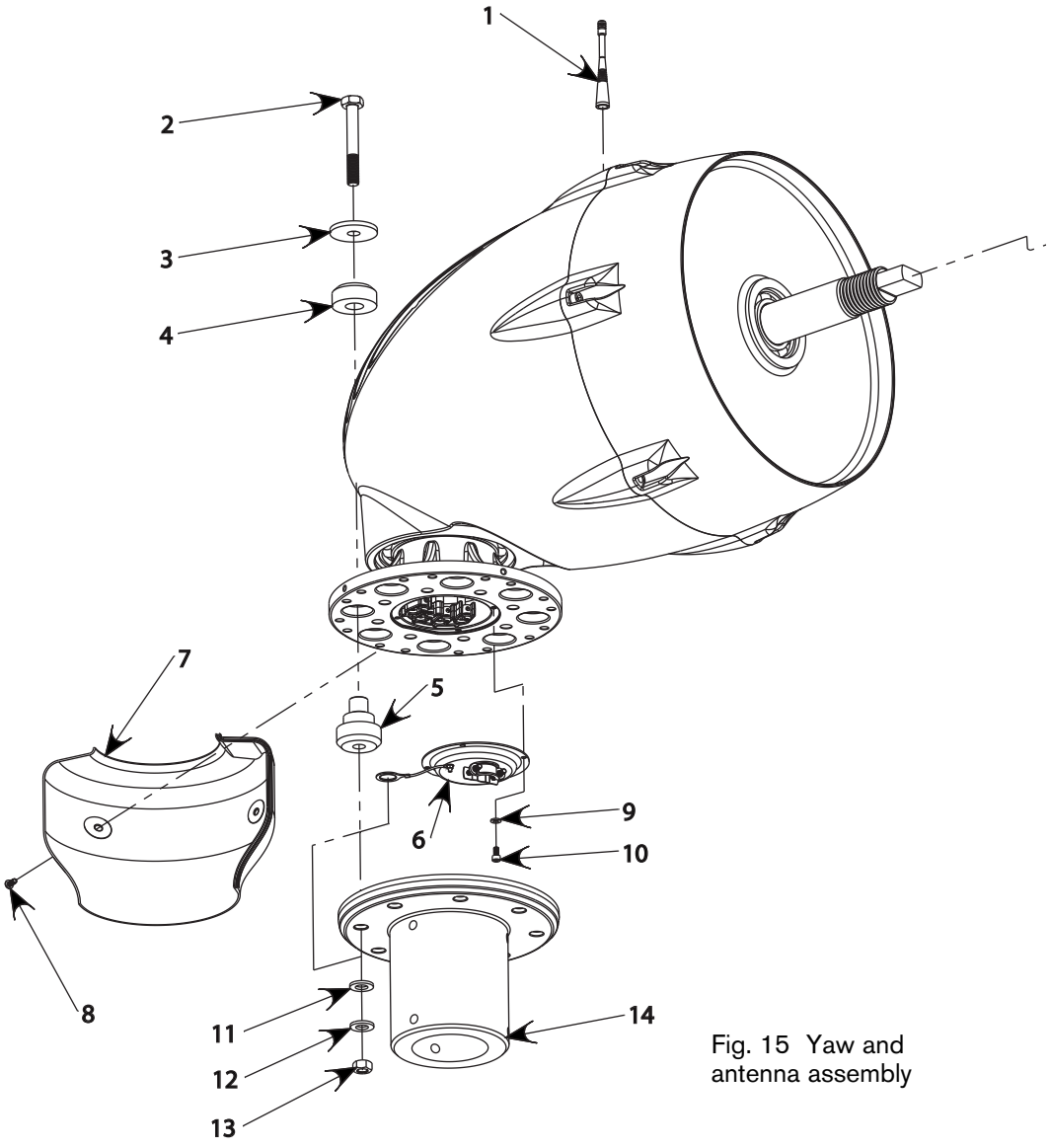



Fig. 15 Yaw and antenna assembly

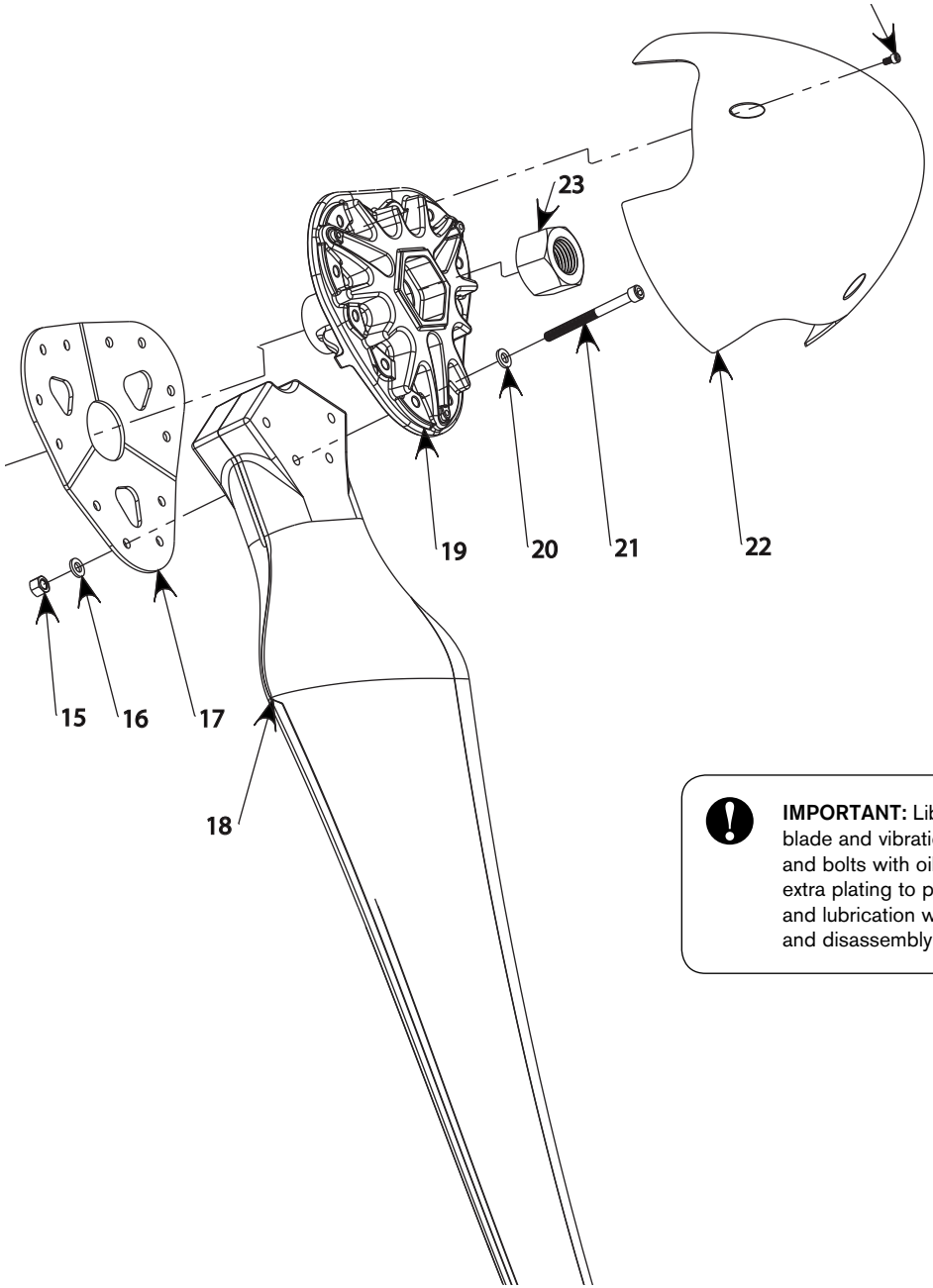



Fig. 16 Blade and nosecone assembly

**IMPORTANT:** Liberally lubricate blade and vibration mounting nuts and bolts with oil. Fasteners have extra plating to prevent corrosion and lubrication will ease assembly and disassembly.

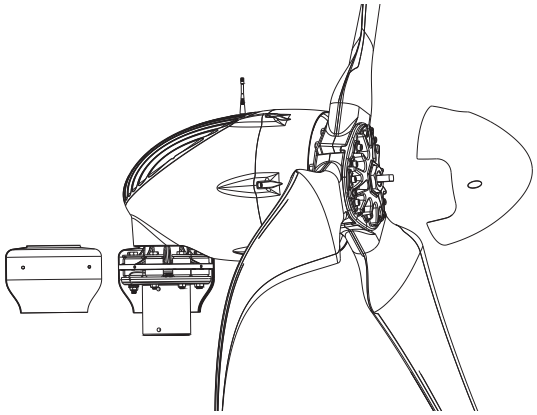


Fig. 17 Completed assembly

| Yaw Components | | |
|---|---|---|
| # | Description | Qty. |
| 1 | RF Antenna | 1 |
| 2 | M12x1.75x90mm Hex Bolt grade 10.9 | 8 |
| 3 | Snubbing Washer | 8 |
| 4, 5 | Vibration Isolation Ring (4) and Bushing (5) | 8 |
| 6 | Strain Relief Cover Assembly | 1 |
| 7 | Shield | 2 |
| 8 | M5x.8x12mm Button Head grade 8.8 | 4 |
| 9 | M5 Lock Washer A2 stainless steel | 4 |
| 10 | M5x.8x12mm Bolt SHCS grade 8.8 | 4 |
| 11 | Flat Washer (M12) A2 stainless steel | 8 |
| 12 | Lock Washer (M12) A2 stainless steel | 8 |
| 13 | M12x1.75 Nut grade 10.9 | 8 |
| 14 | 5" Tower Insert (optional) | 1 |
| **Blade Components** | | |
| # | Description | Qty. |
| 15 | M10x1.5 Nut grade 12.9 | 12 |
| 16 | Lock Washer (M10) A2 stainless steel | 12 |
| 17 | Blade Plate | 1 |
| 18 | Blade | 3 |
| 19 | Blade Hub | 1 |
| 20 | Flat Washer (M10) A2 stainless steel | 12 |
| 21 | M10x1.3x120mm Bolt SHCS grade 12.9 | 12 |
| 22 | Nose Cone | 1 |
| 23 | Hub Retaining Nut grade 10.9 | 1 |
| 24 | M6x1x12mm Bolt SHCS grade 8.8 | 3 |

# Three - Operation & Maintenance

## 3-1 Skystream 3.7™ Key Operating Characteristics

### Procedure for Starting and Stopping Skystream

The procedure to start and stop the Skystream is at the dedicated Skystream breaker on the main electrical panel. The Skystream is turned on by switching the breaker "ON", thereby connecting the Skystream to the electrical grid. After a five minute delay, the Skystream will release the internal brake, and begin producing electricity (when there are sufficient winds). The procedure for turning off the Skystream is to switch the electrical breaker to "OFF", thereby disconnecting the Skystream from the electrical grid. The Skystream can be turned off, at any time, for any reason. When the Skystream is "OFF", there is no live electrical wires between the main electrical panel and the Skystream.

**Warning:** Power to Skystream MUST BE TURNED OFF prior to servicing

The Skystream 3.7 operates by converting the kinetic energy of the wind into rotational motion that turns an alternator and ultimately produces usable electric power. In actuality this is a great over simplification of Skystream's operation since it must very precisely match the frequency and voltage of the electricity supplied by the local utility company in order to power your home and its appliances. Additionally, Skystream monitors and adjusts its performance to provide safe operation and extract the maximum energy from even low speed winds.

Skystream will begin producing power in a wind of approximately 8 mph (3.5 m/sec). At that speed the blades will rotate at approximately 120 rpm. Once it has started producing power, it will continue to produce power at lower speeds down to 80 rpm and less than 3 m/s. As the wind speed increases the blade speed will also increase. At about 20 mph (9 m/sec) the blades achieves a rotational speed of 325 rpm. This is Skystream's rated speed. Should the wind speed increase above 20 mph the blade speed will remain essentially fixed at 325 rpm.

If a condition occurs that causes the rotational speed to exceed 360 rpm, Skystream will shut down for approximately 10 minutes after which it will resume normal operation unless a fault is detected causing it to remain shut down. This is an unlikely scenario that should never occur in normal operation. It is important to set the elevation for the turbine to operate correctly. If it is not set, the turbine may experience premature shut downs.

If a wind gust exceeds 56 mph (25 m/s), then the Skystream will shutdown for 1 hour. After 1 hour, the Skystream will turn back on, and resume normal charging. If the wind is still above 56 mph (25 m/s), then the Skystream will shutdown for another hour.

In addition to adjusting its operation in response to wind conditions Skystream also monitors the electrical utility grid and its own internal health. Should the electric utility voltage or frequency differ from Skystream's voltage, for example due to a power failure, Skystream will disconnect from the grid and enter a "braked mode". While in this mode the blades are held stationary while the Skystream monitors the utility power. If Skystream determines that the power has returned to within specification, it will re-connect to the grid and resume normal operation. This is the same cycle that occurs when Skystream is initially powered.

Additionally, should Skystream determine an internal fault exists it will execute an emergency shutdown – an E-stop. An E-stop will only take place if a severe fault that requires servicing internal components has occurred. For that reason resetting an E-stop requires gaining access to the interior of Skystream. It cannot be reset from the ground.

**As a final note, Skystream is factory configured for operation up to 3,300 feet (1000 m) above sea level. If your installation exceeds this elevation please consult Southwest Windpower technical service for assistance in resetting the configurations for your elevation.**

### 3-2 Electronic Stall Regulation

The Skystream 3.7 has the ability to adjust the rotational speed of its blades or even stop the blades if required by ambient conditions. This referred to as Stall Control and it is accomplished by adjusting the current draw from the alternator. The higher the current draw the greater the electromagnetic torque applied to the rotor and if enough torque is applied the blades will slow or even stop. In simple terms the inverter is demanding more power than the available wind can provide thus causing the blade rotational speed to decrease.

As a safety feature the alternator is capable of producing approximately five times the torque required to control the turbine. This extra available power means that even if segments of the alternator windings are damaged there is still sufficient torque to stop the turbine.

While Skystream is connected to the utility grid it constantly monitors that all conditions, for example grid voltage and frequency, are within limits. If the inverter determines that all operating conditions are within limits, it opens three Normally Closed (NC) relays, RL1, 2 and 3, removing the short from the alternator windings and allowing the blades to spin freely. Only then will it operate the DPDT Grid Relay RL_G to allow the inverter to export power to the grid. Refer to the Skystream Block Diagram in Appendix A. Should the inverter sense an abnormal condition, for example high current in the alternator windings by means of the current sensors on the relay board it will close relays RL1, 2, and 3 thereby stopping the turbine. In turn, the DPDT Relay RL_G will be operated to the position where the inverter power exporting circuitry is disconnected from the grid.

### 3-3 Redundant Relay Switch Control

As a redundant measure of safety to guarantee stopping the turbine in case of a winding fault or a lost connection to the alternator; there are seven connections to the alternator windings, but only three are necessary to control or stop the turbine. And as a final measure of safety, if the inverter is unable to control the rotational speed and Skystream exceeds approximately 400 rpm, the rectified voltage will exceed the Zener (Z) voltage on the relay board, causing the latching relay (RL4) to open. This will cause the relays RL1, 2, and 3 to close and apply all the available electromechanical torque to the rotor, stopping Skystream completely. The inverter power path will also be disconnected from the grid my means of relay RL_G. This is the final level of control and is only applied when all other methods of control have failed. As such, once set, (latched) RL4 may only be reset by gaining internal access to Skystream – it cannot be reset via the Remote Display.

**Warning:** Power to Skystream MUST BE TURNED OFF prior to servicing

### 3-4 Shutting Down the Skystream for Maintenance

Power to Skystream MUST be turned off prior to servicing. Turn off power by opening the disconnect switch at the base of the tower, if available, or by opening the appropriate circuit breakers in the main service panel.

Turning off the power accomplishes two objectives: removal of the electrical shock hazard and locking the Skystream rotor by causing the inverter to close relays RL1, RL2 and RL3 and thereby shorting the alternator windings as described in Section 3 -2 Electronic Stall Regulation. It also disconnects the inverter power path from the grid by means of relay RL_G.

The Skystream rotor will remain locked in this manner up to any speed within the IEC Class II regime (less than 140 mph or 62.5 m/s). Refer to Section 3 -1 Skystream Key Operating Characteristics for a description of the wind speed conditions that may cause Skystream to shut down.

#### Maintenance and Inspection

The Skystream is designed for 20 years of maintenance-free operation. All bearings and components were designed for a 20 year life at a site with an average annual wind speed of 19 mph (8.5 m/s). This type of site corresponds to a an IEC wind class II, under the IEC 61400-2 Small Wind Turbine Safety Standard.

#### Yearly Inspection

Although the Skystream is designed to be maintenance-free for 20 years, the Skystream owner should perform the following yearly inspections. The yearly inspection can be performed without lowering the tower, or otherwise gaining access to the turbine. The results from this yearly inspection should be written in a Skystream logbook.

While the turbine is operating in moderate winds, listen for any abnormal noises. After the first year of operation, you should be aware of the normal operating sounds from the Skystream. Normal noises include aerodynamic swishing, and the humming of the power electronics. If you notice any abnormal sounds, then record your observations in your Skystream logbook, and then call Southwest Windpower Technical Support.

The second part of the yearly inspection is to make detailed observations of the Skystream from the ground. Shut off the Skystream by disconnecting the Skystream from the grid, by turning the breaker to “OFF”, at the main electrical panel (see “Procedure for Starting and Stopping Skystream”). Turning off the Skystream will cause the blades to stop or spin very slowly in all wind speeds. With a pair of binoculars take very careful observations of the Skystream. Look for any problems with the blades such as cracks, or damage to the edges of the rotor blade. Look at the face and nacelle of the Skystream and note any potential damage. If you notice any damage during your yearly inspection, then write down your observations in your Skystream Logbook, and call Southwest Windpower Technical Support.

#### Turbine Access

In the event you have a need to gain access to the Skystream, for whatever reason, then the following procedures should be followed. Turn off the Skystream by disconnecting the Skystream from the electrical grid (see “Procedure for Starting and Stopping Skystream”). This is done at the dedicated Skystream electrical breaker located at the main electrical panel. This disconnect procedure will both stop the rotor, and disconnect the grid power to the Skystream, thereby making it safe to work on.

**Warning:** Prior to lowering or gaining access to Skystream with a man-lift, follow the procedure for the proper shutdown of the wind turbine. DO NOT work on Skystream if it is connected to the grid.

Be sure the Skystream is shutdown before proceeding any further. If you have a tilt-up tower, then lower the tower following the procedure for your particular tower. Rest the tower on a few supports before it gets to the ground. There is not a need to lock the rotor and yaw prior to working on the Skystream if it was lowered to the ground on a tilt-up tower.

If you are gaining access to the tower through the use of a man-lift, or equivalent, then it is important to lock the rotor and yaw prior to working on the Skystream at the top of the tower. This can be done by tightly tying a rope around the rotor blades and tower.

One such method for doing this is to tie a clove-hitch, or equivalent, around the tower, and then wrap the rope ends around the blades and tie together with a square knot. This will prevent the Skystream rotor blades from spinning, and the nacelle from yawing, while you are working on the unit on the tower-top.

**The following items should be checked while you have access to the Skystream:**

- Remove the yaw shield, and wipe off any grease that may have seeped from the yaw bearing.
- Verify the yaw bearing snap ring is still properly seated in the snap ring groove within the nacelle. (this is the spiral ring located just below the yaw bearing).
- Check the tightness of the (8) yaw bolts with a torque wrench. All yaw bolts should be torqued to 80 ft-lbs (108 N-m).
- Reinstall the yaw shield and secure the fasteners using Loctite 242 (i.e. removable blue threadlocker).
- Check tightness of blade bolts with torque wrench. All blade bolts should be torqued to 50 ft-lbs (68 N-m).
- Clean the rotor blades with a mild soap and water. Remove as much of the dead bug matter as possible from the blades.
- Look for any problems with the blades such as cracks, or damage to the edges of the rotor blade.
- Inspect the face, nacelle, and the rest of the Skystream and note any potential damage or problem.
- If you notice any damage or problem during your inspection, then write down your observations in your Skystream Logbook, and call Southwest Windpower Technical Support.

If you are using a tilt-up tower, then raise the tower following the instructions for your tower. If you are at the tower-top in a man-lift, then remove the rope tying the rotor blades to the tower, prior to being lowered back to the ground. Check that the tower is properly secured to the foundation.

Turn on the Skystream by switching the dedicated Skystream breaker to “ON”, at the main electrical panel (see “Procedure for Starting and Stopping Skystream”). After a five minute delay, the Skystream internal brake will release, and then the blades will be free to rotate. The Skystream will then be back online and ready to produce electricity from the wind.”

## 3-5 Frequently Asked Questions

**1) What happens if I lose power from my utility company?**

If there is a power outage the Skystream will shut down within one second. It will resume normal operation when power is restored. There are many safety requirements of a utility-tied inverter. The Skystream meets all of these requirements per UL 1741.

**2) Does the Skystream have lightning protection?**

Yes, the Skystream has lightning protection. The Skystream can handle 6000 Volts as required by UL 1741. If you live in a lightning prone area SWWP recommends an additional lightning arrestor at the base of the tower.

**3) What should I do if I'm expecting a severe storm?**

The Skystream is designed for very high winds, but it is always a good idea to shut Skystream down if there is going to be a severe storm to protect against any flying debris.

**4) How do I shut down Skystream?**

To turn off Skystream all you need to do is turn off the breaker Skystream is connected to. This will cause NO damage to the unit.

**5) Can I leave Skystream unattended?**

Yes, the Skystream is designed to operate without any user input. If there is any fault it will shut down on its own.

**6) What do I do if Skystream is facing upwind even though there is a strong wind?**

If the Skystream is not tracking correctly, you should check to see if the tower is level.

**7) When should I contact an authorized service technician?**

a. If there is any unusual vibration coming from Skystream.
b. If you hear any noise that sounds like mechanical interference.
c. If the Skystream is connected to the utility power (i.e. all breakers and disconnects are turned on), the wind is blowing, but the Skystream is not turning very fast.

**8) Can I mount Skystream to my roof?**

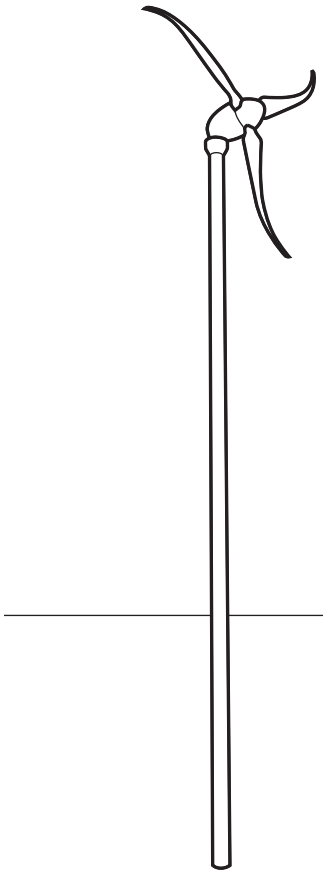
Roof and building mount is not recommended. Because of the size and weight of the wind generator, Skystream needs to be mounted on a PE certified tower to ensure the quietest and safest system. Roof mounting will invalidate the warranty.

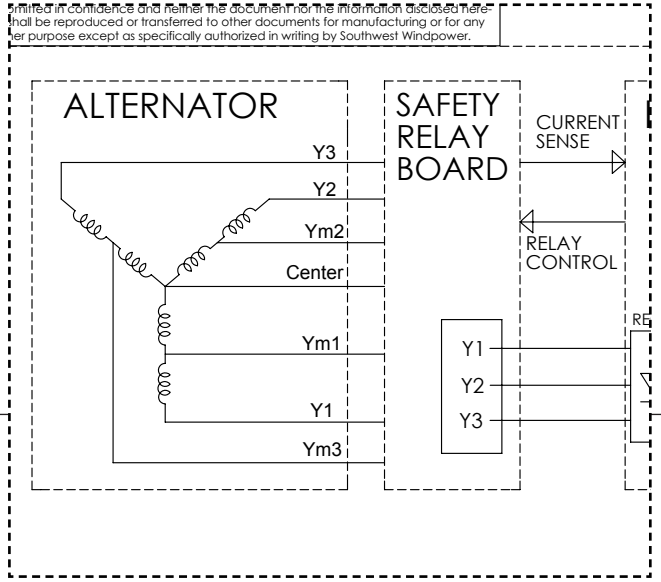
SKYSTREAM 3.7™

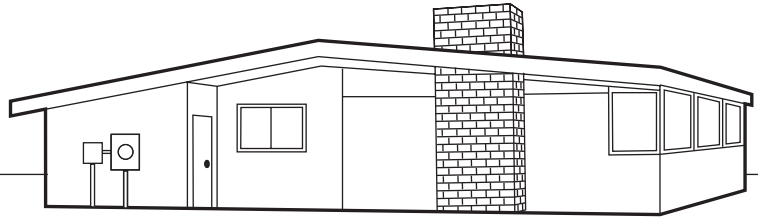
Southwest Windpower, Inc.
1801 West Route 66
Flagstaff, Arizona 86001
Phone: 928.779.9463
Fax: 928.779.1485
www.skystreamenergy.com

# SKYSTREAM 3.7™

## APPENDIX A
## ELECTRICAL DIAGRAMS





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# Skystream 3.7 Owner's Manual

## Appendix A: Electrical Diagrams


1) **GRID CONNECTION OPTION A:**
120/240 V, 60 Hz, Split Phase, Junction Box at Tower Base ____ **3**

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3) **GRID CONNECTION OPTION C:**
120/208 V, 60 Hz, 3 Phase, Junction Box at Tower Base ____ **5**

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120/208 V, 60 Hz, 3 Phase, Without Junction Box at Tower Base ____ **6**

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120/240 V Battery Charging, Grid Connected Using Autotransformer and Inverter ____ **13**

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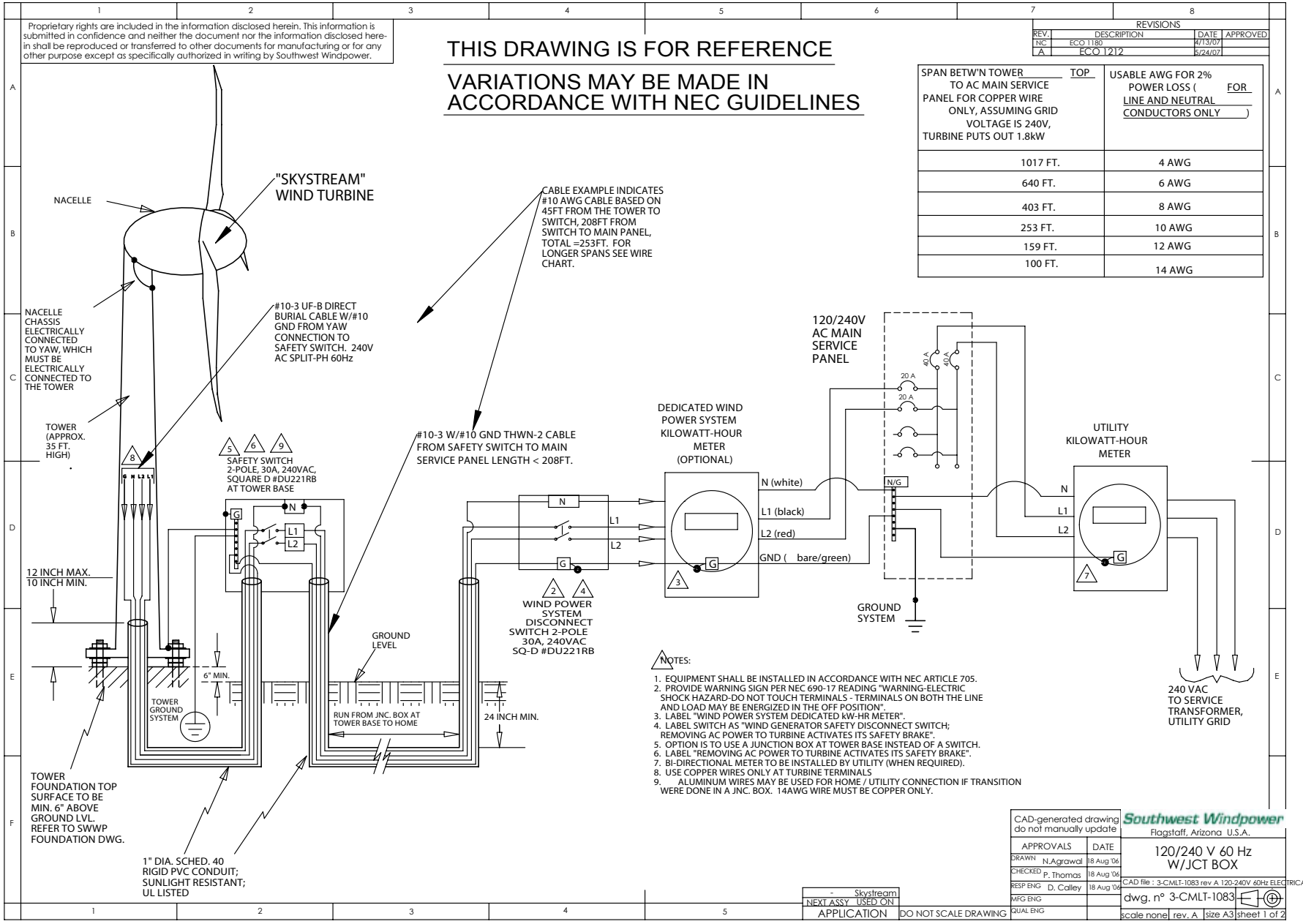
120 V Battery Charging, Grid Connected Using Single Inverter ____ **14**

13) **SKYSTREAM BLOCK DIAGRAM** ____ **15**

Fig. 1. Grid Connection Option A: 120/240 V, 60 Hz, Split Phase, Junction Box at Tower Base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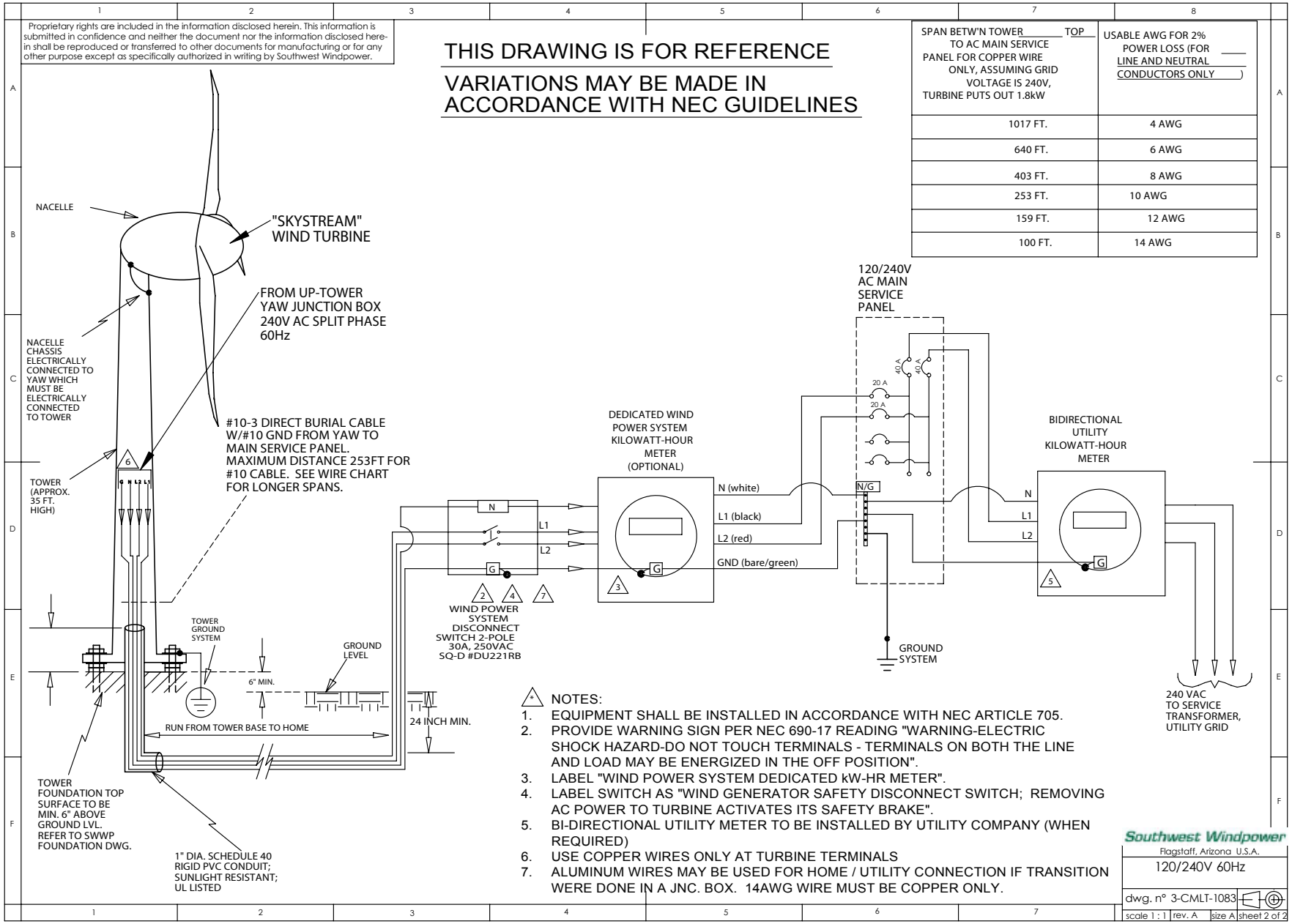
THIS DRAWING IS FOR REFERENCE
VARIATIONS MAY BE MADE IN ACCORDANCE WITH NEC GUIDELINES
REVISIONS
REV. DESCRIPTION DATE APPROVED
NC ECO 1180 4/13/07
A ECO 1212 5/24/07
SPAN BETW'N TOWER TOP TO AC MAIN SERVICE PANEL FOR COPPER WIRE ONLY, ASSUMING GRID VOLTAGE IS 240V, TURBINE PUTS OUT 1.8kW
USABLE AWG FOR 2% POWER LOSS ( FOR LINE AND NEUTRAL CONDUCTORS ONLY )
1017 FT. 4 AWG
640 FT. 6 AWG
403 FT. 8 AWG
253 FT. 10 AWG
159 FT. 12 AWG
100 FT. 14 AWG
"SKYSTREAM" WIND TURBINE
NACELLE
CABLE EXAMPLE INDICATES #10 AWG CABLE BASED ON 45FT FROM THE TOWER TO SWITCH, 208FT FROM SWITCH TO MAIN PANEL, TOTAL =253FT. FOR LONGER SPANS SEE WIRE CHART.
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW, WHICH MUST BE ELECTRICALLY CONNECTED TO THE TOWER
#10-3 UF-B DIRECT BURIAL CABLE W/#10 GND FROM YAW CONNECTION TO SAFETY SWITCH. 240V AC SPLIT-PH 60Hz
TOWER (APPROX. 35 FT. HIGH)
#10-3 W/#10 GND THWN-2 CABLE FROM SAFETY SWITCH TO MAIN SERVICE PANEL LENGTH < 208FT.
120/240V AC MAIN SERVICE PANEL
40 A
40 A
20 A
20 A
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER (OPTIONAL)
UTILITY KILOWATT-HOUR METER
SAFETY SWITCH 2-POLE, 30A, 240VAC, SQUARE D #DU221RB AT TOWER BASE
N (white)
L1 (black)
L2 (red)
GND ( bare/green)
N
L1
L2
G
N/G
WIND POWER SYSTEM DISCONNECT SWITCH 2-POLE 30A, 240VAC SQ-D #DU221RB
GROUND SYSTEM
12 INCH MAX.
10 INCH MIN.
6" MIN.
GROUND LEVEL
TOWER GROUND SYSTEM
RUN FROM JNC. BOX AT TOWER BASE TO HOME
24 INCH MIN.
240 VAC TO SERVICE TRANSFORMER, UTILITY GRID
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHED. 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH NEC ARTICLE 705.
2. PROVIDE WARNING SIGN PER NEC 690-17 READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
5. OPTION IS TO USE A JUNCTION BOX AT TOWER BASE INSTEAD OF A SWITCH.
6. LABEL "REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
7. BI-DIRECTIONAL METER TO BE INSTALLED BY UTILITY (WHEN REQUIRED).
8. USE COPPER WIRES ONLY AT TURBINE TERMINALS
9. ALUMINUM WIRES MAY BE USED FOR HOME / UTILITY CONNECTION IF TRANSITION WERE DONE IN A JNC. BOX. 14AWG WIRE MUST BE COPPER ONLY.
CAD-generated drawing do not manually update
APPROVALS DATE
DRAWN N.Agrawal 18 Aug '06
CHECKED P. Thomas 18 Aug '06
RESP ENG D. Calley 18 Aug '06
MFG ENG
QUAL ENG
Southwest Windpower
Flagstaff, Arizona U.S.A.
120/240 V 60 Hz W/JCT BOX
CAD file : 3-CMLT-1083 rev A 120-240V 60Hz ELECTRICAL CONN
dwg. n° 3-CMLT-1083
scale none rev. A size A3 sheet 1 of 2
- Skystream
NEXT ASSY USED ON
APPLICATION
DO NOT SCALE DRAWING

Fig 2. Grid Connection Option B: 120/240 V, 60 Hz, Split Phase, Without Junction Box at Tower Base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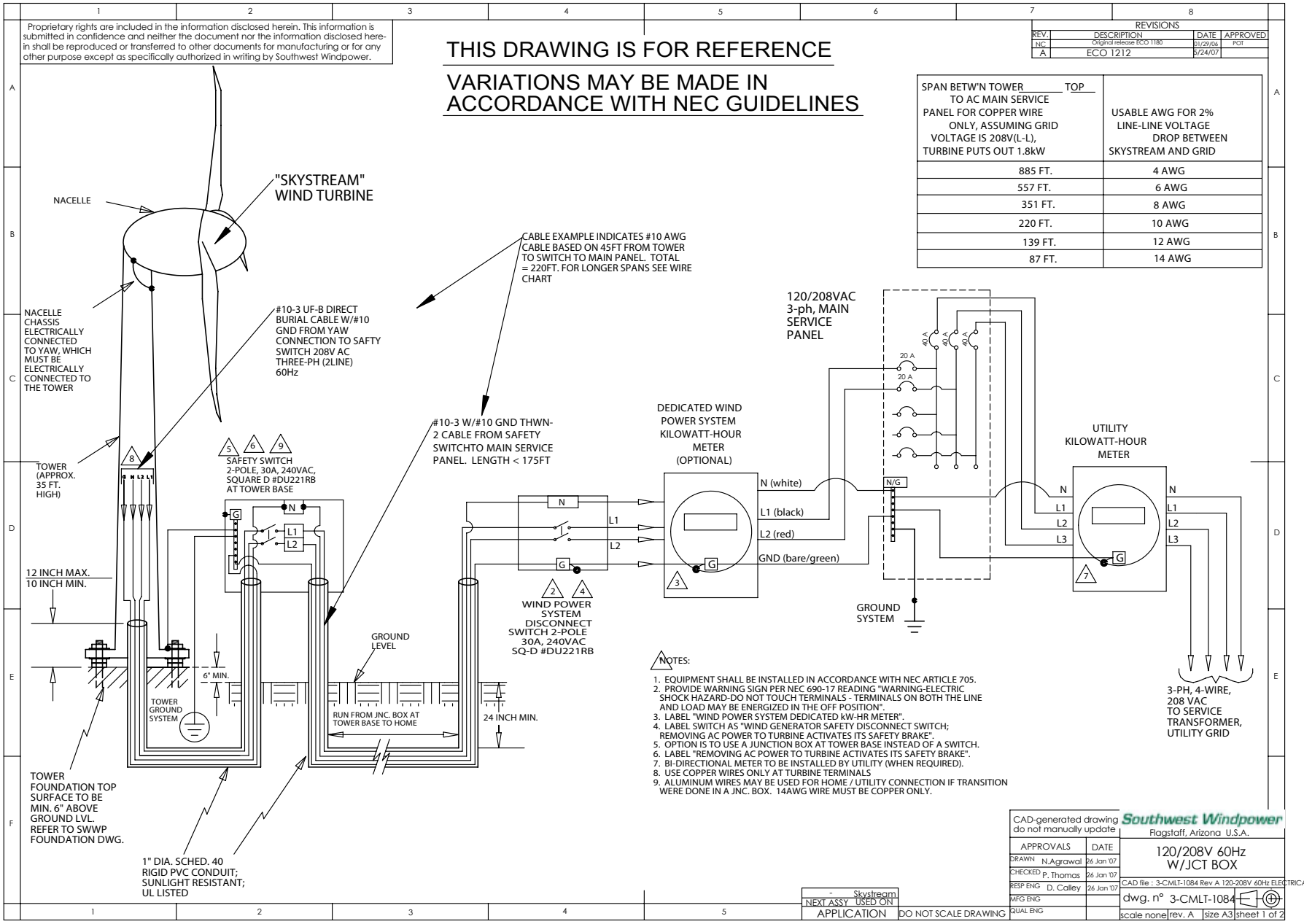
THIS DRAWING IS FOR REFERENCE
VARIATIONS MAY BE MADE IN ACCORDANCE WITH NEC GUIDELINES
SPAN BETW'N TOWER TOP TO AC MAIN SERVICE PANEL FOR COPPER WIRE ONLY, ASSUMING GRID VOLTAGE IS 240V, TURBINE PUTS OUT 1.8kW
USABLE AWG FOR 2% POWER LOSS (FOR LINE AND NEUTRAL CONDUCTORS ONLY)
1017 FT. 4 AWG
640 FT. 6 AWG
403 FT. 8 AWG
253 FT. 10 AWG
159 FT. 12 AWG
100 FT. 14 AWG
NACELLE
"SKYSTREAM" WIND TURBINE
FROM UP-TOWER YAW JUNCTION BOX 240V AC SPLIT PHASE 60Hz
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW WHICH MUST BE ELECTRICALLY CONNECTED TO TOWER
#10-3 DIRECT BURIAL CABLE W/#10 GND FROM YAW TO MAIN SERVICE PANEL. MAXIMUM DISTANCE 253FT FOR #10 CABLE. SEE WIRE CHART FOR LONGER SPANS.
TOWER (APPROX. 35 FT. HIGH)
TOWER GROUND SYSTEM
GROUND LEVEL
6" MIN.
24 INCH MIN.
RUN FROM TOWER BASE TO HOME
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHEDULE 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
120/240V AC MAIN SERVICE PANEL
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER (OPTIONAL)
BIDIRECTIONAL UTILITY KILOWATT-HOUR METER
N (white)
L1 (black)
L2 (red)
GND (bare/green)
WIND POWER SYSTEM DISCONNECT SWITCH 2-POLE 30A, 250VAC SQ-D #DU221RB
GROUND SYSTEM
240 VAC TO SERVICE TRANSFORMER, UTILITY GRID
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH NEC ARTICLE 705.
2. PROVIDE WARNING SIGN PER NEC 690-17 READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
5. BI-DIRECTIONAL UTILITY METER TO BE INSTALLED BY UTILITY COMPANY (WHEN REQUIRED)
6. USE COPPER WIRES ONLY AT TURBINE TERMINALS
7. ALUMINUM WIRES MAY BE USED FOR HOME / UTILITY CONNECTION IF TRANSITION WERE DONE IN A JNC. BOX. 14AWG WIRE MUST BE COPPER ONLY.
Southwest Windpower
Flagstaff, Arizona U.S.A.
120/240V 60Hz
dwg. n° 3-CMLT-1083
scale 1 : 1 rev. A size A sheet 2 of 2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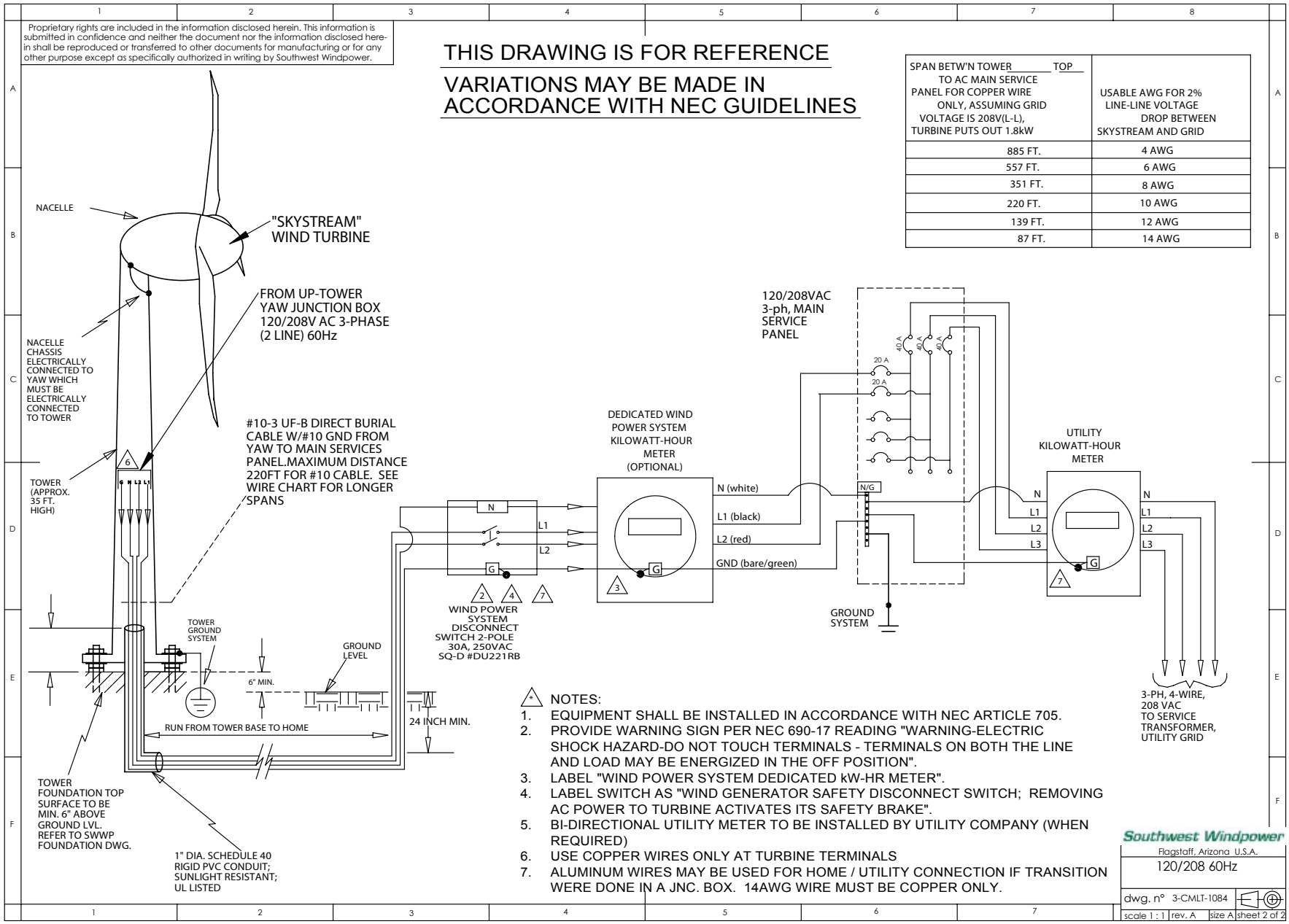
REVISIONS
REV. DESCRIPTION DATE APPROVED
NC Original release ECO 1180 01/29/06 POT
A ECO 1212 5/24/07
SPAN BETW'N TOWER TOP TO AC MAIN SERVICE PANEL FOR COPPER WIRE ONLY, ASSUMING GRID VOLTAGE IS 208V(L-L), TURBINE PUTS OUT 1.8kW
USABLE AWG FOR 2% LINE-LINE VOLTAGE DROP BETWEEN SKYSTREAM AND GRID
885 FT. 4 AWG
557 FT. 6 AWG
351 FT. 8 AWG
220 FT. 10 AWG
139 FT. 12 AWG
87 FT. 14 AWG
"SKYSTREAM" WIND TURBINE
NACELLE
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW, WHICH MUST BE ELECTRICALLY CONNECTED TO THE TOWER
TOWER (APPROX. 35 FT. HIGH)
#10-3 UF-B DIRECT BURIAL CABLE W/#10 GND FROM YAW CONNECTION TO SAFTY SWITCH 208V AC THREE-PH (2LINE) 60Hz
CABLE EXAMPLE INDICATES #10 AWG CABLE BASED ON 45FT FROM TOWER TO SWITCH TO MAIN PANEL. TOTAL = 220FT. FOR LONGER SPANS SEE WIRE CHART
SAFETY SWITCH 2-POLE, 30A, 240VAC, SQUARE D #DU221RB AT TOWER BASE
#10-3 W/#10 GND THWN-2 CABLE FROM SAFETY SWITCHTO MAIN SERVICE PANEL. LENGTH < 175FT
120/208VAC 3-ph, MAIN SERVICE PANEL
40 A
20 A
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER (OPTIONAL)
UTILITY KILOWATT-HOUR METER
N (white)
L1 (black)
L2 (red)
GND (bare/green)
12 INCH MAX.
10 INCH MIN.
6" MIN.
GROUND LEVEL
TOWER GROUND SYSTEM
RUN FROM JNC. BOX AT TOWER BASE TO HOME
24 INCH MIN.
WIND POWER SYSTEM DISCONNECT SWITCH 2-POLE 30A, 240VAC SQ-D #DU221RB
GROUND SYSTEM
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHED. 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
3-PH, 4-WIRE, 208 VAC TO SERVICE TRANSFORMER, UTILITY GRID
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH NEC ARTICLE 705.
2. PROVIDE WARNING SIGN PER NEC 690-17 READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
5. OPTION IS TO USE A JUNCTION BOX AT TOWER BASE INSTEAD OF A SWITCH.
6. LABEL "REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
7. BI-DIRECTIONAL METER TO BE INSTALLED BY UTILITY (WHEN REQUIRED).
8. USE COPPER WIRES ONLY AT TURBINE TERMINALS
9. ALUMINUM WIRES MAY BE USED FOR HOME / UTILITY CONNECTION IF TRANSITION WERE DONE IN A JNC. BOX. 14AWG WIRE MUST BE COPPER ONLY.
CAD-generated drawing do not manually update
Southwest Windpower
Flagstaff, Arizona U.S.A.
APPROVALS DATE
DRAWN N.Agrawal 26 Jan '07
CHECKED P. Thomas 26 Jan '07
RESP ENG D. Calley 26 Jan '07
MFG ENG
QUAL ENG
120/208V 60Hz W/JCT BOX
CAD file : 3-CMLT-1084 Rev A 120-208V 60Hz ELECTRICAL CON
dwg. n° 3-CMLT-1084
scale none rev. A size A3 sheet 1 of 2
- Skystream
NEXT ASSY USED ON
APPLICATION DO NOT SCALE DRAWING

Fig. 4. Grid Connection Option D:120/208 V, 60 Hz, 3 Phase, Without Junction Box at Tower Base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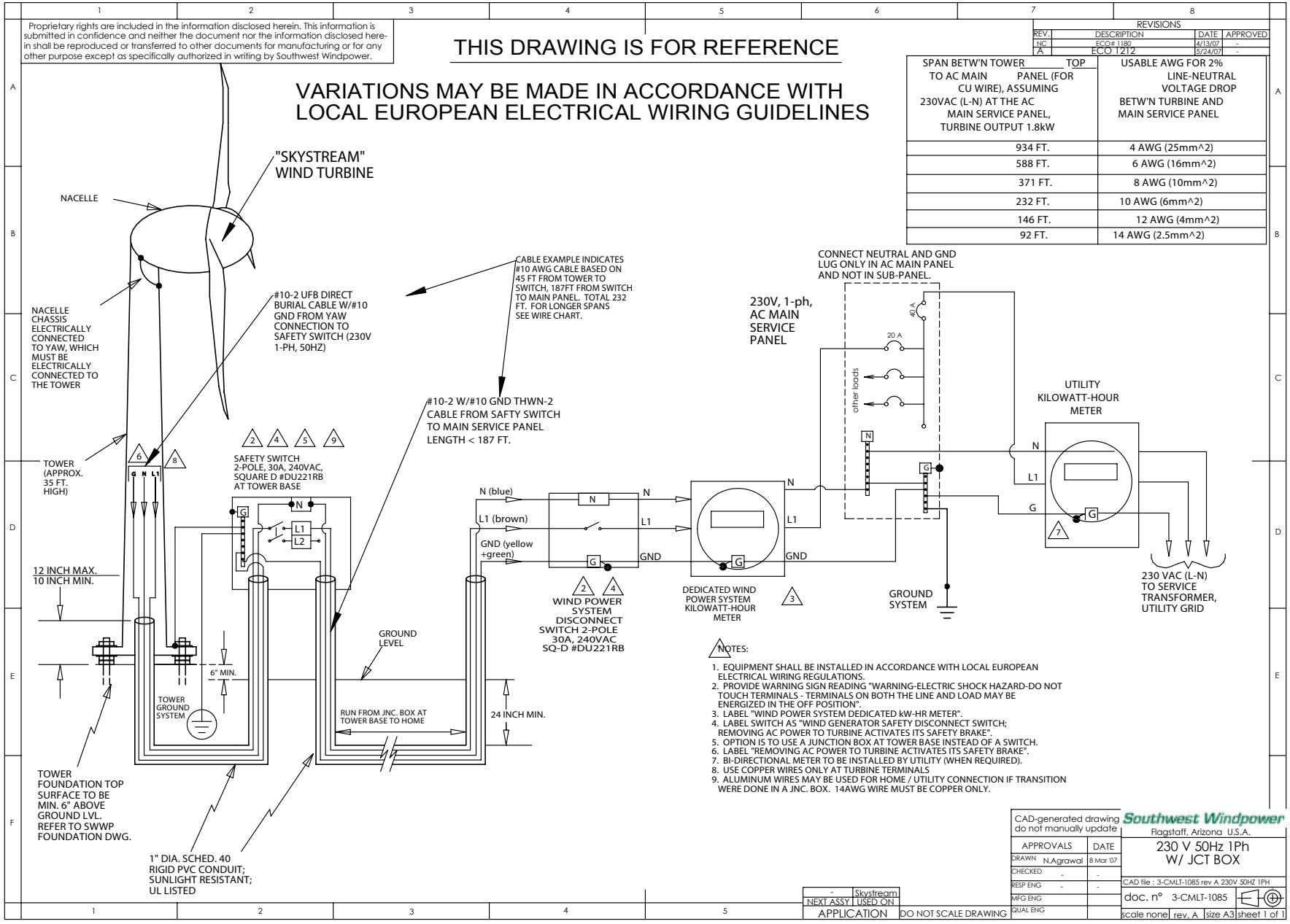
USABLE AWG FOR 2% LINE-LINE VOLTAGE DROP BETWEEN SKYSTREAM AND GRID
885 FT. 4 AWG
557 FT. 6 AWG
351 FT. 8 AWG
220 FT. 10 AWG
139 FT. 12 AWG
87 FT. 14 AWG
NACELLE
"SKYSTREAM" WIND TURBINE
FROM UP-TOWER YAW JUNCTION BOX 120/208V AC 3-PHASE (2 LINE) 60Hz
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW WHICH MUST BE ELECTRICALLY CONNECTED TO TOWER
TOWER (APPROX. 35 FT. HIGH)
#10-3 UF-B DIRECT BURIAL CABLE W/#10 GND FROM YAW TO MAIN SERVICES PANEL.MAXIMUM DISTANCE 220FT FOR #10 CABLE. SEE WIRE CHART FOR LONGER SPANS
120/208VAC 3-ph, MAIN SERVICE PANEL
20 A
20 A
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER (OPTIONAL)
UTILITY KILOWATT-HOUR METER
N (white)
L1 (black)
L2 (red)
GND (bare/green)
N/G
N
L1
L2
L3
WIND POWER SYSTEM DISCONNECT SWITCH 2-POLE 30A, 250VAC SQ-D #DU221RB
GROUND SYSTEM
TOWER GROUND SYSTEM
GROUND LEVEL
6" MIN.
24 INCH MIN.
RUN FROM TOWER BASE TO HOME
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHEDULE 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
3-PH, 4-WIRE, 208 VAC TO SERVICE TRANSFORMER, UTILITY GRID
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH NEC ARTICLE 705.
2. PROVIDE WARNING SIGN PER NEC 690-17 READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
5. BI-DIRECTIONAL UTILITY METER TO BE INSTALLED BY UTILITY COMPANY (WHEN REQUIRED)
6. USE COPPER WIRES ONLY AT TURBINE TERMINALS
7. ALUMINUM WIRES MAY BE USED FOR HOME / UTILITY CONNECTION IF TRANSITION WERE DONE IN A JNC. BOX. 14AWG WIRE MUST BE COPPER ONLY.
Southwest Windpower
Flagstaff, Arizona U.S.A.
120/208 60Hz
dwg. n° 3-CMLT-1084
scale 1 : 1 rev. A size A sheet 2 of 2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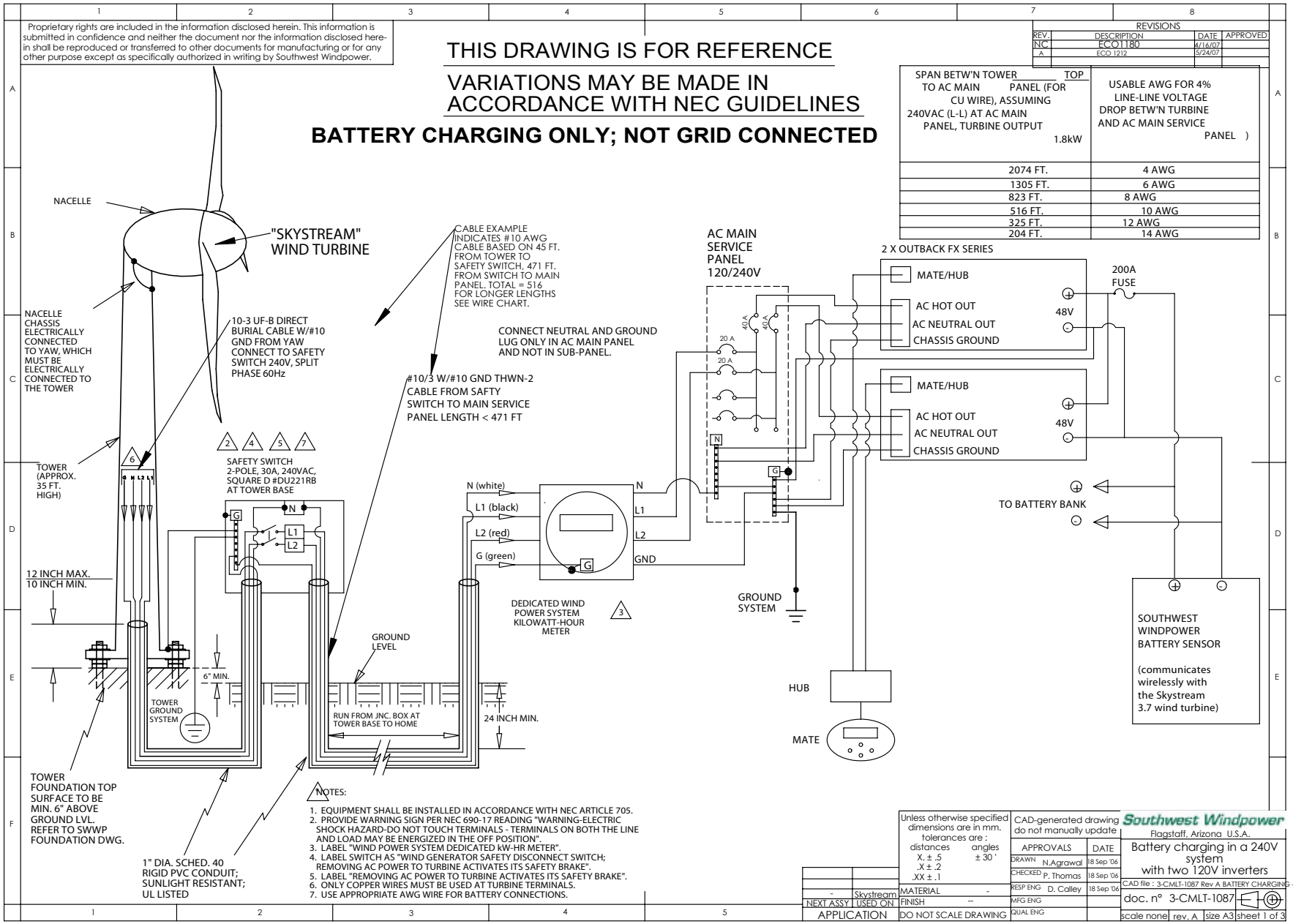
THIS DRAWING IS FOR REFERENCE
VARIATIONS MAY BE MADE IN ACCORDANCE WITH LOCAL EUROPEAN ELECTRICAL WIRING GUIDELINES
REVISIONS
REV. | DESCRIPTION | DATE | APPROVED
NC | ECO# 1180 | 4/13/07 | -
A | ECO 1212 | 5/24/07 | -
SPAN BETW'N TOWER TOP TO AC MAIN PANEL (FOR CU WIRE), ASSUMING 230VAC (L-N) AT THE AC MAIN SERVICE PANEL, TURBINE OUTPUT 1.8kW
USABLE AWG FOR 2% LINE-NEUTRAL VOLTAGE DROP BETW'N TURBINE AND MAIN SERVICE PANEL
934 FT. | 4 AWG (25mm^2)
588 FT. | 6 AWG (16mm^2)
371 FT. | 8 AWG (10mm^2)
232 FT. | 10 AWG (6mm^2)
146 FT. | 12 AWG (4mm^2)
92 FT. | 14 AWG (2.5mm^2)
"SKYSTREAM" WIND TURBINE
NACELLE
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW, WHICH MUST BE ELECTRICALLY CONNECTED TO THE TOWER
#10-2 UFB DIRECT BURIAL CABLE W/#10 GND FROM YAW CONNECTION TO SAFETY SWITCH (230V 1-PH, 50HZ)
CABLE EXAMPLE INDICATES #10 AWG CABLE BASED ON 45 FT FROM TOWER TO SWITCH, 187FT FROM SWITCH TO MAIN PANEL. TOTAL 232 FT. FOR LONGER SPANS SEE WIRE CHART.
#10-2 W/#10 GND THWN-2 CABLE FROM SAFTY SWITCH TO MAIN SERVICE PANEL LENGTH < 187 FT.
CONNECT NEUTRAL AND GND LUG ONLY IN AC MAIN PANEL AND NOT IN SUB-PANEL.
230V, 1-ph, AC MAIN SERVICE PANEL
40 A
20 A
other loads
UTILITY KILOWATT-HOUR METER
TOWER (APPROX. 35 FT. HIGH)
G N L1
SAFETY SWITCH 2-POLE, 30A, 240VAC, SQUARE D #DU221RB AT TOWER BASE
N (blue)
L1 (brown)
GND (yellow +green)
WIND POWER SYSTEM DISCONNECT SWITCH 2-POLE 30A, 240VAC SQ-D #DU221RB
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER
GROUND SYSTEM
230 VAC (L-N) TO SERVICE TRANSFORMER, UTILITY GRID
12 INCH MAX.
10 INCH MIN.
GROUND LEVEL
6" MIN.
TOWER GROUND SYSTEM
RUN FROM JNC. BOX AT TOWER BASE TO HOME
24 INCH MIN.
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHED. 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH LOCAL EUROPEAN ELECTRICAL WIRING REGULATIONS.
2. PROVIDE WARNING SIGN READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
5. OPTION IS TO USE A JUNCTION BOX AT TOWER BASE INSTEAD OF A SWITCH.
6. LABEL "REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
7. BI-DIRECTIONAL METER TO BE INSTALLED BY UTILITY (WHEN REQUIRED).
8. USE COPPER WIRES ONLY AT TURBINE TERMINALS
9. ALUMINUM WIRES MAY BE USED FOR HOME / UTILITY CONNECTION IF TRANSITION WERE DONE IN A JNC. BOX. 14AWG WIRE MUST BE COPPER ONLY.
CAD-generated drawing do not manually update
Southwest Windpower
Flagstaff, Arizona U.S.A.
APPROVALS | DATE
DRAWN N.Agrawal | 8 Mar '07
CHECKED - | -
RESP ENG - | -
MFG ENG
QUAL ENG
230 V 50Hz 1Ph W/ JCT BOX
CAD file : 3-CMLT-1085 rev A 230V 50HZ 1PH
doc. n° 3-CMLT-1085
scale none | rev. A | size A3 | sheet 1 of 1
NEXT ASSY | USED ON
- | Skystream
APPLICATION
DO NOT SCALE DRAWING

Fig. 6. Battery Backup Option A: 120/240 V Battery Charging System Using Dual Inverters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THIS DRAWING IS FOR REFERENCE
VARIATIONS MAY BE MADE IN ACCORDANCE WITH NEC GUIDELINES
BATTERY CHARGING ONLY; NOT GRID CONNECTED
REVISIONS
REV. DESCRIPTION DATE APPROVED
NC ECO1180 4/16/07
A ECO 1212 5/24/07
SPAN BETW'N TOWER TO AC MAIN PANEL (FOR CU WIRE), ASSUMING 240VAC (L-L) AT AC MAIN PANEL, TURBINE OUTPUT 1.8kW
TOP
USABLE AWG FOR 4% LINE-LINE VOLTAGE DROP BETW'N TURBINE AND AC MAIN SERVICE PANEL )
2074 FT. 4 AWG
1305 FT. 6 AWG
823 FT. 8 AWG
516 FT. 10 AWG
325 FT. 12 AWG
204 FT. 14 AWG
NACELLE
"SKYSTREAM" WIND TURBINE
CABLE EXAMPLE INDICATES #10 AWG CABLE BASED ON 45 FT. FROM TOWER TO SAFETY SWITCH, 471 FT. FROM SWITCH TO MAIN PANEL. TOTAL = 516 FOR LONGER LENGTHS SEE WIRE CHART.
AC MAIN SERVICE PANEL 120/240V
2 X OUTBACK FX SERIES
MATE/HUB
AC HOT OUT
AC NEUTRAL OUT
CHASSIS GROUND
48V
200A FUSE
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW, WHICH MUST BE ELECTRICALLY CONNECTED TO THE TOWER
10-3 UF-B DIRECT BURIAL CABLE W/#10 GND FROM YAW CONNECT TO SAFETY SWITCH 240V, SPLIT PHASE 60Hz
CONNECT NEUTRAL AND GROUND LUG ONLY IN AC MAIN PANEL AND NOT IN SUB-PANEL.
#10/3 W/#10 GND THWN-2 CABLE FROM SAFTY SWITCH TO MAIN SERVICE PANEL LENGTH < 471 FT
TOWER (APPROX. 35 FT. HIGH)
SAFETY SWITCH 2-POLE, 30A, 240VAC, SQUARE D #DU221RB AT TOWER BASE
N (white)
L1 (black)
L2 (red)
G (green)
N
L1
L2
GND
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER
GROUND SYSTEM
TO BATTERY BANK
SOUTHWEST WINDPOWER BATTERY SENSOR
(communicates wirelessly with the Skystream 3.7 wind turbine)
12 INCH MAX.
10 INCH MIN.
GROUND LEVEL
6" MIN.
TOWER GROUND SYSTEM
RUN FROM JNC. BOX AT TOWER BASE TO HOME
24 INCH MIN.
HUB
MATE
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHED. 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH NEC ARTICLE 705.
2. PROVIDE WARNING SIGN PER NEC 690-17 READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
5. LABEL "REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
6. ONLY COPPER WIRES MUST BE USED AT TURBINE TERMINALS.
7. USE APPROPRIATE AWG WIRE FOR BATTERY CONNECTIONS.
Unless otherwise specified dimensions are in mm. tolerances are : distances X. ± .5 .X ± .2 .XX ± .1 angles ± 30 '
CAD-generated drawing do not manually update
APPROVALS DATE
DRAWN N.Agrawal 18 Sep '06
CHECKED P. Thomas 18 Sep '06
RESP ENG D. Calley 18 Sep '06
MFG ENG
QUAL ENG
MATERIAL -
FINISH --
DO NOT SCALE DRAWING
NEXT ASSY Skystream
USED ON
APPLICATION
Southwest Windpower
Flagstaff, Arizona U.S.A.
Battery charging in a 240V system with two 120V inverters
CAD file : 3-CMLT-1087 Rev A BATTERY CHARGING - ELECTRIC/
doc. n° 3-CMLT-1087
scale none rev. A size A3 sheet 1 of 3

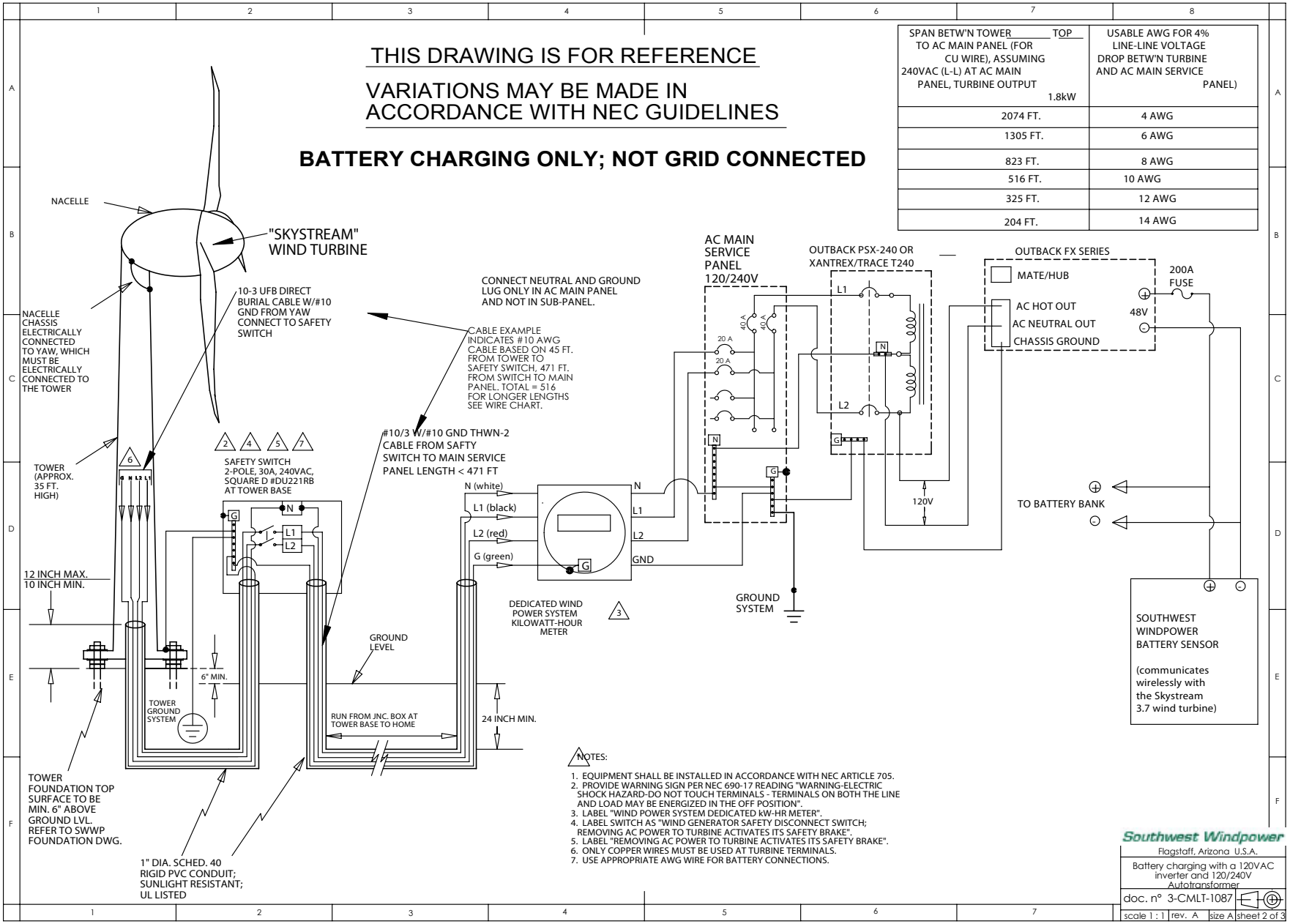

THIS DRAWING IS FOR REFERENCE
VARIATIONS MAY BE MADE IN ACCORDANCE WITH NEC GUIDELINES
BATTERY CHARGING ONLY; NOT GRID CONNECTED
SPAN BETW'N TOWER TOP TO AC MAIN PANEL (FOR CU WIRE), ASSUMING 240VAC (L-L) AT AC MAIN PANEL, TURBINE OUTPUT 1.8kW
USABLE AWG FOR 4% LINE-LINE VOLTAGE DROP BETW'N TURBINE AND AC MAIN SERVICE PANEL)
2074 FT. 4 AWG
1305 FT. 6 AWG
823 FT. 8 AWG
516 FT. 10 AWG
325 FT. 12 AWG
204 FT. 14 AWG
NACELLE
"SKYSTREAM" WIND TURBINE
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW, WHICH MUST BE ELECTRICALLY CONNECTED TO THE TOWER
10-3 UFB DIRECT BURIAL CABLE W/#10 GND FROM YAW CONNECT TO SAFETY SWITCH
CONNECT NEUTRAL AND GROUND LUG ONLY IN AC MAIN PANEL AND NOT IN SUB-PANEL.
CABLE EXAMPLE INDICATES #10 AWG CABLE BASED ON 45 FT. FROM TOWER TO SAFETY SWITCH, 471 FT. FROM SWITCH TO MAIN PANEL. TOTAL = 516 FOR LONGER LENGTHS SEE WIRE CHART.
#10/3 W/#10 GND THWN-2 CABLE FROM SAFTY SWITCH TO MAIN SERVICE PANEL LENGTH < 471 FT
TOWER (APPROX. 35 FT. HIGH)
SAFETY SWITCH 2-POLE, 30A, 240VAC, SQUARE D #DU221RB AT TOWER BASE
AC MAIN SERVICE PANEL 120/240V
OUTBACK PSX-240 OR XANTREX/TRACE T240
OUTBACK FX SERIES
MATE/HUB
AC HOT OUT
AC NEUTRAL OUT
CHASSIS GROUND
200A FUSE
48V
N (white)
L1 (black)
L2 (red)
G (green)
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER
120V
TO BATTERY BANK
GROUND SYSTEM
SOUTHWEST WINDPOWER BATTERY SENSOR
(communicates wirelessly with the Skystream 3.7 wind turbine)
12 INCH MAX.
10 INCH MIN.
GROUND LEVEL
6" MIN.
TOWER GROUND SYSTEM
RUN FROM JNC. BOX AT TOWER BASE TO HOME
24 INCH MIN.
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHED. 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH NEC ARTICLE 705.
2. PROVIDE WARNING SIGN PER NEC 690-17 READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
5. LABEL "REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
6. ONLY COPPER WIRES MUST BE USED AT TURBINE TERMINALS.
7. USE APPROPRIATE AWG WIRE FOR BATTERY CONNECTIONS.
Southwest Windpower
Flagstaff, Arizona U.S.A.
Battery charging with a 120VAC inverter and 120/240V Autotransformer
doc. n° 3-CMLT-1087
scale 1 : 1 rev. A size A sheet 2 of 3

Fig. 8. Battery Backup Option C: 120 V Battery Charging System Using Single Inverter

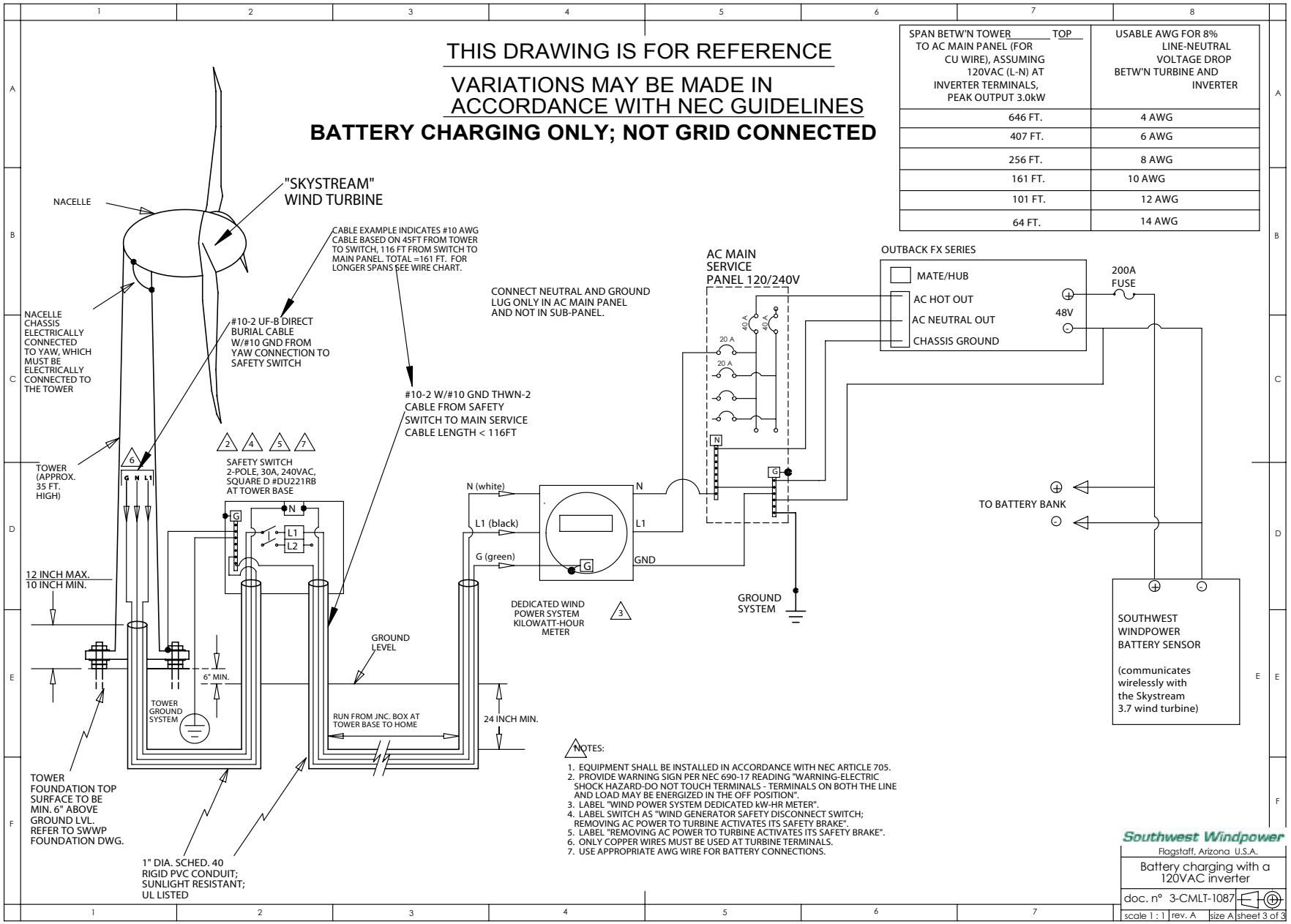
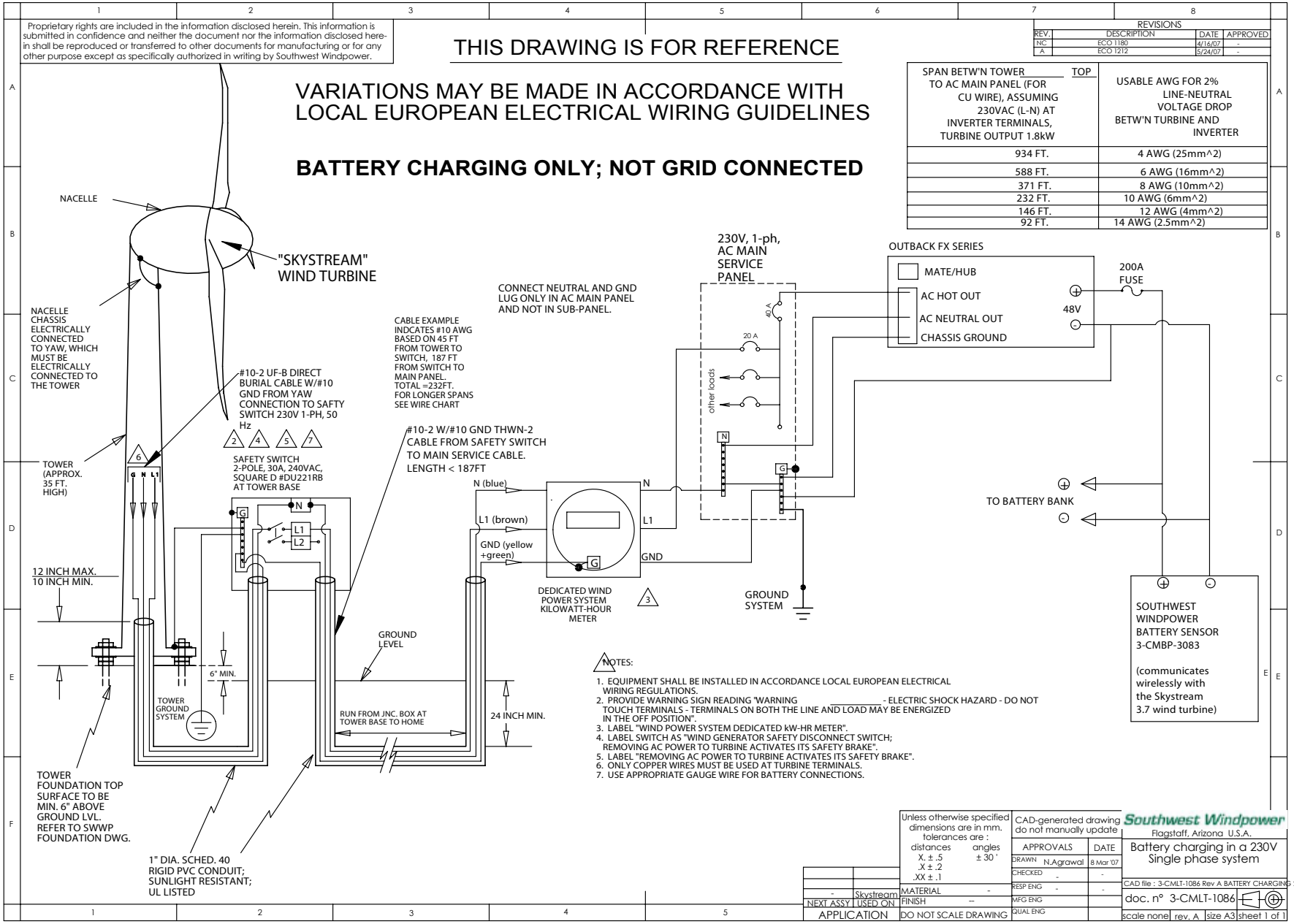

THIS DRAWING IS FOR REFERENCE
VARIATIONS MAY BE MADE IN ACCORDANCE WITH NEC GUIDELINES
BATTERY CHARGING ONLY; NOT GRID CONNECTED
SPAN BETW'N TOWER TOP TO AC MAIN PANEL (FOR CU WIRE), ASSUMING 120VAC (L-N) AT INVERTER TERMINALS, PEAK OUTPUT 3.0kW
USABLE AWG FOR 8% LINE-NEUTRAL VOLTAGE DROP BETW'N TURBINE AND INVERTER
646 FT. 4 AWG
407 FT. 6 AWG
256 FT. 8 AWG
161 FT. 10 AWG
101 FT. 12 AWG
64 FT. 14 AWG
NACELLE
"SKYSTREAM" WIND TURBINE
CABLE EXAMPLE INDICATES #10 AWG CABLE BASED ON 45FT FROM TOWER TO SWITCH, 116 FT FROM SWITCH TO MAIN PANEL. TOTAL =161 FT. FOR LONGER SPANS SEE WIRE CHART.
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW, WHICH MUST BE ELECTRICALLY CONNECTED TO THE TOWER
#10-2 UF-B DIRECT BURIAL CABLE W/#10 GND FROM YAW CONNECTION TO SAFETY SWITCH
CONNECT NEUTRAL AND GROUND LUG ONLY IN AC MAIN PANEL AND NOT IN SUB-PANEL.
AC MAIN SERVICE PANEL 120/240V
OUTBACK FX SERIES
MATE/HUB
AC HOT OUT
AC NEUTRAL OUT
CHASSIS GROUND
48V
200A FUSE
#10-2 W/#10 GND THWN-2 CABLE FROM SAFETY SWITCH TO MAIN SERVICE CABLE LENGTH < 116FT
TOWER (APPROX. 35 FT. HIGH)
SAFETY SWITCH 2-POLE, 30A, 240VAC, SQUARE D #DU221RB AT TOWER BASE
N (white)
L1 (black)
G (green)
GND
TO BATTERY BANK
12 INCH MAX.
10 INCH MIN.
GROUND LEVEL
6" MIN.
TOWER GROUND SYSTEM
RUN FROM JNC. BOX AT TOWER BASE TO HOME
24 INCH MIN.
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER
GROUND SYSTEM
SOUTHWEST WINDPOWER BATTERY SENSOR
(communicates wirelessly with the Skystream 3.7 wind turbine)
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHED. 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH NEC ARTICLE 705.
2. PROVIDE WARNING SIGN PER NEC 690-17 READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
5. LABEL "REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
6. ONLY COPPER WIRES MUST BE USED AT TURBINE TERMINALS.
7. USE APPROPRIATE AWG WIRE FOR BATTERY CONNECTIONS.
Southwest Windpower
Flagstaff, Arizona U.S.A.
Battery charging with a 120VAC inverter
doc. n° 3-CMLT-1087
scale 1 : 1 rev. A size A sheet 3 of 3

Fig. 9. Battery Backup Option D: 230 V, 1 Phase, Junction Box at Tower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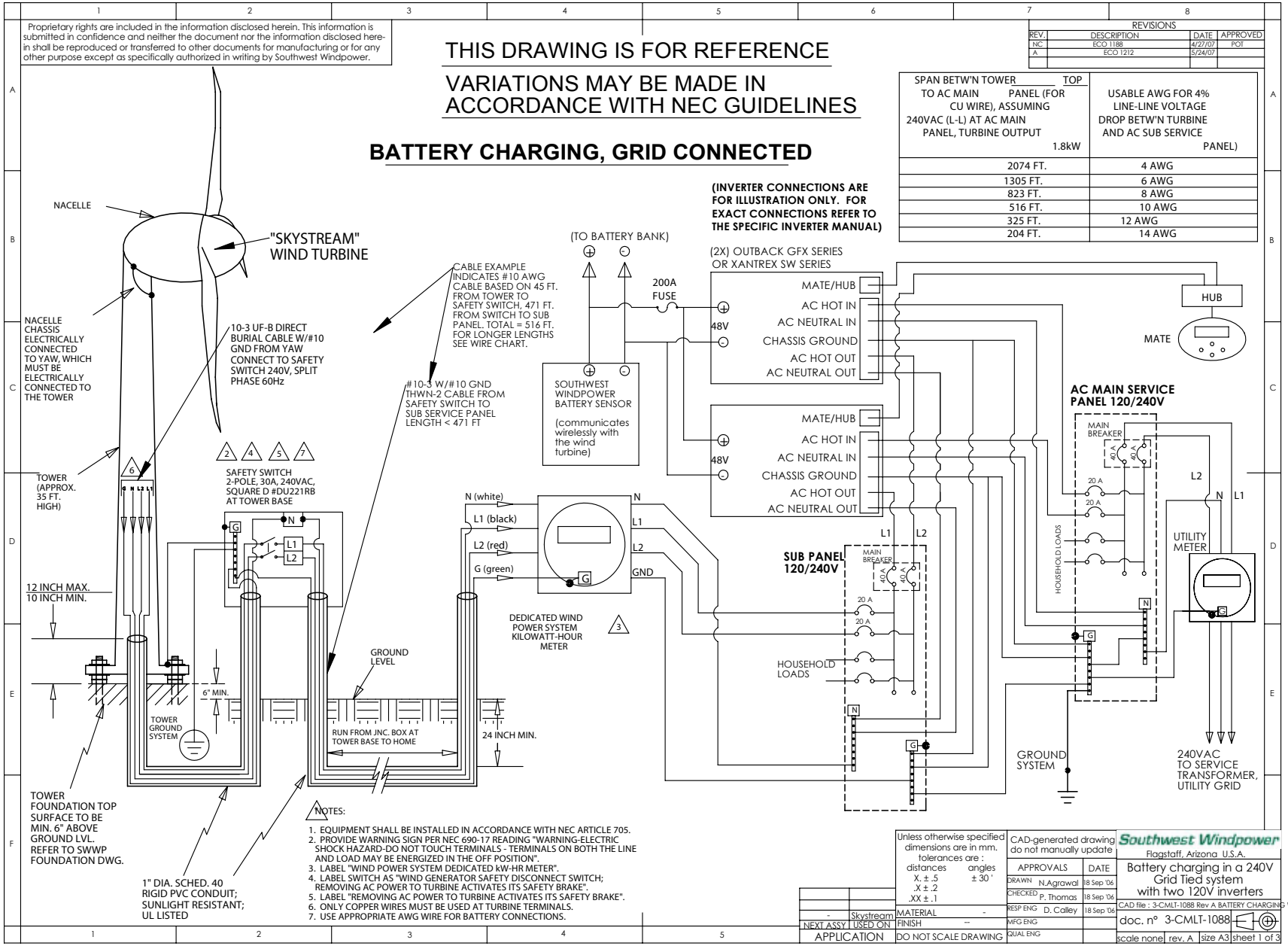
THIS DRAWING IS FOR REFERENCE
VARIATIONS MAY BE MADE IN ACCORDANCE WITH LOCAL EUROPEAN ELECTRICAL WIRING GUIDELINES
BATTERY CHARGING ONLY; NOT GRID CONNECTED
REVISIONS
REV. DESCRIPTION DATE APPROVED
NC ECO 1180 4/16/07 -
A ECO 1212 5/24/07 -
SPAN BETW'N TOWER TO AC MAIN PANEL (FOR CU WIRE), ASSUMING 230VAC (L-N) AT INVERTER TERMINALS, TURBINE OUTPUT 1.8kW
USABLE AWG FOR 2% LINE-NEUTRAL VOLTAGE DROP BETW'N TURBINE AND INVERTER
934 FT. 4 AWG (25mm^2)
588 FT. 6 AWG (16mm^2)
371 FT. 8 AWG (10mm^2)
232 FT. 10 AWG (6mm^2)
146 FT. 12 AWG (4mm^2)
92 FT. 14 AWG (2.5mm^2)
NACELLE
"SKYSTREAM" WIND TURBINE
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW, WHICH MUST BE ELECTRICALLY CONNECTED TO THE TOWER
#10-2 UF-B DIRECT BURIAL CABLE W/#10 GND FROM YAW CONNECTION TO SAFTY SWITCH 230V 1-PH, 50 Hz
TOWER (APPROX. 35 FT. HIGH)
SAFETY SWITCH 2-POLE, 30A, 240VAC, SQUARE D #DU221RB AT TOWER BASE
CABLE EXAMPLE INDCATES #10 AWG BASED ON 45 FT FROM TOWER TO SWITCH, 187 FT FROM SWITCH TO MAIN PANEL. TOTAL =232FT. FOR LONGER SPANS SEE WIRE CHART
#10-2 W/#10 GND THWN-2 CABLE FROM SAFETY SWITCH TO MAIN SERVICE CABLE. LENGTH < 187FT
CONNECT NEUTRAL AND GND LUG ONLY IN AC MAIN PANEL AND NOT IN SUB-PANEL.
230V, 1-ph, AC MAIN SERVICE PANEL
OUTBACK FX SERIES
MATE/HUB
AC HOT OUT
AC NEUTRAL OUT
CHASSIS GROUND
200A FUSE
48V
40 A
20 A
other loads
TO BATTERY BANK
N (blue)
L1 (brown)
GND (yellow +green)
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER
GROUND SYSTEM
SOUTHWEST WINDPOWER BATTERY SENSOR 3-CMBP-3083
(communicates wirelessly with the Skystream 3.7 wind turbine)
12 INCH MAX.
10 INCH MIN.
GROUND LEVEL
6" MIN.
TOWER GROUND SYSTEM
RUN FROM JNC. BOX AT TOWER BASE TO HOME
24 INCH MIN.
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHED. 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE LOCAL EUROPEAN ELECTRICAL WIRING REGULATIONS.
2. PROVIDE WARNING SIGN READING "WARNING _____ - ELECTRIC SHOCK HAZARD - DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
5. LABEL "REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
6. ONLY COPPER WIRES MUST BE USED AT TURBINE TERMINALS.
7. USE APPROPRIATE GAUGE WIRE FOR BATTERY CONNECTIONS.
Unless otherwise specified dimensions are in mm. tolerances are : distances X. ± .5 .X ± .2 .XX ± .1 angles ± 30 '
MATERIAL -
FINISH --
DO NOT SCALE DRAWING
CAD-generated drawing do not manually update
APPROVALS DATE
DRAWN N.Agrawal 8 Mar '07
CHECKED -
RESP ENG -
MFG ENG
QUAL ENG
Southwest Windpower
Flagstaff, Arizona U.S.A.
Battery charging in a 230V Single phase system
CAD file : 3-CMLT-1086 Rev A BATTERY CHARGING 230V 1 PH E
doc. n° 3-CMLT-1086
scale none rev. A size A3 sheet 1 of 1
NEXT ASSY USED ON Skystream
APPLICATION

Fig. 10. Battery Charging, Grid Connected, Option A: 120/240 V Battery Charging, Grid Connected Using Dual Inverters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THIS DRAWING IS FOR REFERENCE
VARIATIONS MAY BE MADE IN ACCORDANCE WITH NEC GUIDELINES
BATTERY CHARGING, GRID CONNECTED
REVISIONS
REV. DESCRIPTION DATE APPROVED
NC ECO 1188 4/27/07 POT
A ECO 1212 5/24/07
SPAN BETW'N TOWER TOP TO AC MAIN PANEL (FOR CU WIRE), ASSUMING 240VAC (L-L) AT AC MAIN PANEL, TURBINE OUTPUT 1.8kW
USABLE AWG FOR 4% LINE-LINE VOLTAGE DROP BETW'N TURBINE AND AC SUB SERVICE PANEL)
2074 FT. 4 AWG
1305 FT. 6 AWG
823 FT. 8 AWG
516 FT. 10 AWG
325 FT. 12 AWG
204 FT. 14 AWG
(INVERTER CONNECTIONS ARE FOR ILLUSTRATION ONLY. FOR EXACT CONNECTIONS REFER TO THE SPECIFIC INVERTER MANUAL)
NACELLE
"SKYSTREAM" WIND TURBINE
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW, WHICH MUST BE ELECTRICALLY CONNECTED TO THE TOWER
10-3 UF-B DIRECT BURIAL CABLE W/#10 GND FROM YAW CONNECT TO SAFETY SWITCH 240V, SPLIT PHASE 60Hz
CABLE EXAMPLE INDICATES #10 AWG CABLE BASED ON 45 FT. FROM TOWER TO SAFETY SWITCH, 471 FT. FROM SWITCH TO SUB PANEL. TOTAL = 516 FT. FOR LONGER LENGTHS SEE WIRE CHART.
#10-3 W/#10 GND THWN-2 CABLE FROM SAFETY SWITCH TO SUB SERVICE PANEL LENGTH < 471 FT
TOWER (APPROX. 35 FT. HIGH)
SAFETY SWITCH 2-POLE, 30A, 240VAC, SQUARE D #DU221RB AT TOWER BASE
12 INCH MAX.
10 INCH MIN.
6" MIN.
TOWER GROUND SYSTEM
GROUND LEVEL
RUN FROM JNC. BOX AT TOWER BASE TO HOME
24 INCH MIN.
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHED. 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
(TO BATTERY BANK)
200A FUSE
SOUTHWEST WINDPOWER BATTERY SENSOR
(communicates wirelessly with the wind turbine)
(2X) OUTBACK GFX SERIES OR XANTREX SW SERIES
MATE/HUB
AC HOT IN
AC NEUTRAL IN
CHASSIS GROUND
AC HOT OUT
AC NEUTRAL OUT
48V
HUB
MATE
AC MAIN SERVICE PANEL 120/240V
MAIN BREAKER
HOUSEHOLD LOADS
UTILITY METER
SUB PANEL 120/240V
N (white)
L1 (black)
L2 (red)
G (green)
GND
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER
GROUND SYSTEM
240VAC TO SERVICE TRANSFORMER, UTILITY GRID
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH NEC ARTICLE 705.
2. PROVIDE WARNING SIGN PER NEC 690-17 READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
5. LABEL "REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
6. ONLY COPPER WIRES MUST BE USED AT TURBINE TERMINALS.
7. USE APPROPRIATE AWG WIRE FOR BATTERY CONNECTIONS.
Unless otherwise specified dimensions are in mm. tolerances are : distances X. ± .5 .X ± .2 .XX ± .1 angles ± 30 '
MATERIAL -
FINISH --
DO NOT SCALE DRAWING
CAD-generated drawing do not manually update
APPROVALS DATE
DRAWN N.Agrawal 18 Sep '06
CHECKED P. Thomas 18 Sep '06
RESP ENG D. Calley 18 Sep '06
MFG ENG
QUAL ENG
NEXT ASSY USED ON - Skystream
APPLICATION
Southwest Windpower
Flagstaff, Arizona U.S.A.
Battery charging in a 240V Grid Tied system with two 120V inverters
CAD file : 3-CMLT-1088 Rev A BATTERY CHARGING WITH GRID
doc. n° 3-CMLT-1088
scale none rev. A size A3 sheet 1 of 3

Fig. 11. Battery Charging, Grid Connected, Option B:
120/240 V Battery Charging, Grid Connected Using Autotransformer and Inverter

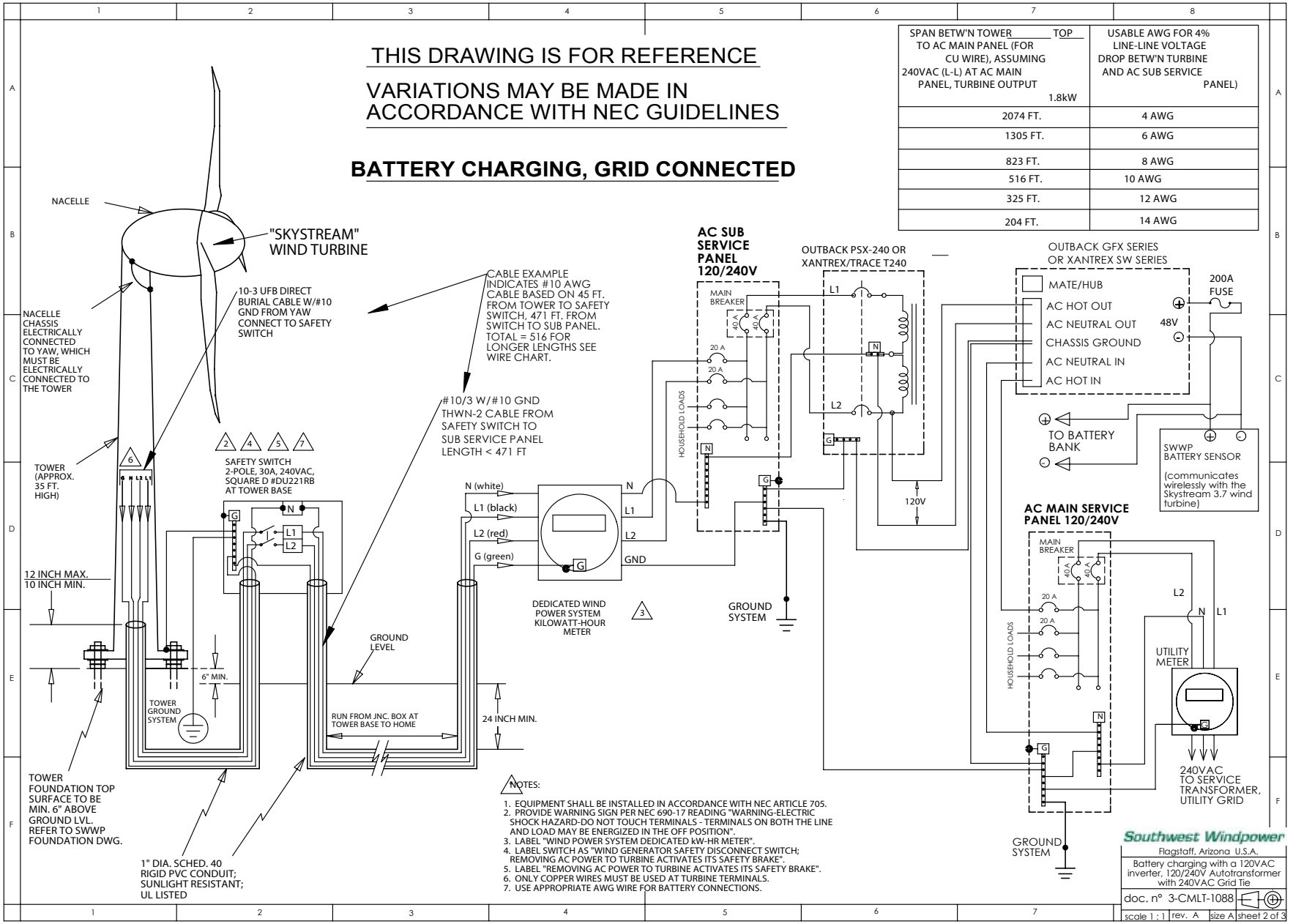

THIS DRAWING IS FOR REFERENCE
VARIATIONS MAY BE MADE IN ACCORDANCE WITH NEC GUIDELINES
BATTERY CHARGING, GRID CONNECTED
SPAN BETW'N TOWER TOP TO AC MAIN PANEL (FOR CU WIRE), ASSUMING 240VAC (L-L) AT AC MAIN PANEL, TURBINE OUTPUT 1.8kW
USABLE AWG FOR 4% LINE-LINE VOLTAGE DROP BETW'N TURBINE AND AC SUB SERVICE PANEL)
2074 FT. 4 AWG
1305 FT. 6 AWG
823 FT. 8 AWG
516 FT. 10 AWG
325 FT. 12 AWG
204 FT. 14 AWG
NACELLE
"SKYSTREAM" WIND TURBINE
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW, WHICH MUST BE ELECTRICALLY CONNECTED TO THE TOWER
10-3 UFB DIRECT BURIAL CABLE W/#10 GND FROM YAW CONNECT TO SAFETY SWITCH
CABLE EXAMPLE INDICATES #10 AWG CABLE BASED ON 45 FT. FROM TOWER TO SAFETY SWITCH, 471 FT. FROM SWITCH TO SUB PANEL. TOTAL = 516 FOR LONGER LENGTHS SEE WIRE CHART.
#10/3 W/#10 GND THWN-2 CABLE FROM SAFETY SWITCH TO SUB SERVICE PANEL LENGTH < 471 FT
TOWER (APPROX. 35 FT. HIGH)
SAFETY SWITCH 2-POLE, 30A, 240VAC, SQUARE D #DU221RB AT TOWER BASE
12 INCH MAX.
10 INCH MIN.
6" MIN.
GROUND LEVEL
TOWER GROUND SYSTEM
RUN FROM JNC. BOX AT TOWER BASE TO HOME
24 INCH MIN.
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHED. 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
N (white)
L1 (black)
L2 (red)
G (green)
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER
GROUND SYSTEM
AC SUB SERVICE PANEL 120/240V
MAIN BREAKER
HOUSEHOLD LOADS
OUTBACK PSX-240 OR XANTREX/TRACE T240
120V
OUTBACK GFX SERIES OR XANTREX SW SERIES
MATE/HUB
AC HOT OUT
AC NEUTRAL OUT
CHASSIS GROUND
AC NEUTRAL IN
AC HOT IN
200A FUSE
48V
TO BATTERY BANK
SWWP BATTERY SENSOR
(communicates wirelessly with the Skystream 3.7 wind turbine)
AC MAIN SERVICE PANEL 120/240V
UTILITY METER
240VAC TO SERVICE TRANSFORMER, UTILITY GRID
GROUND SYSTEM
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH NEC ARTICLE 705.
2. PROVIDE WARNING SIGN PER NEC 690-17 READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES IT'S SAFETY BRAKE".
5. LABEL "REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
6. ONLY COPPER WIRES MUST BE USED AT TURBINE TERMINALS.
7. USE APPROPRIATE AWG WIRE FOR BATTERY CONNECTIONS.
Southwest Windpower
Flagstaff, Arizona U.S.A.
Battery charging with a 120VAC inverter, 120/240V Autotransformer with 240VAC Grid Tie
doc. n° 3-CMLT-1088
scale 1 : 1 rev. A size A sheet 2 of 3

Fig. 12. Battery Charging, Grid Connected, Option C: 120 V Battery Charging, Grid Connected Using Single Inverter

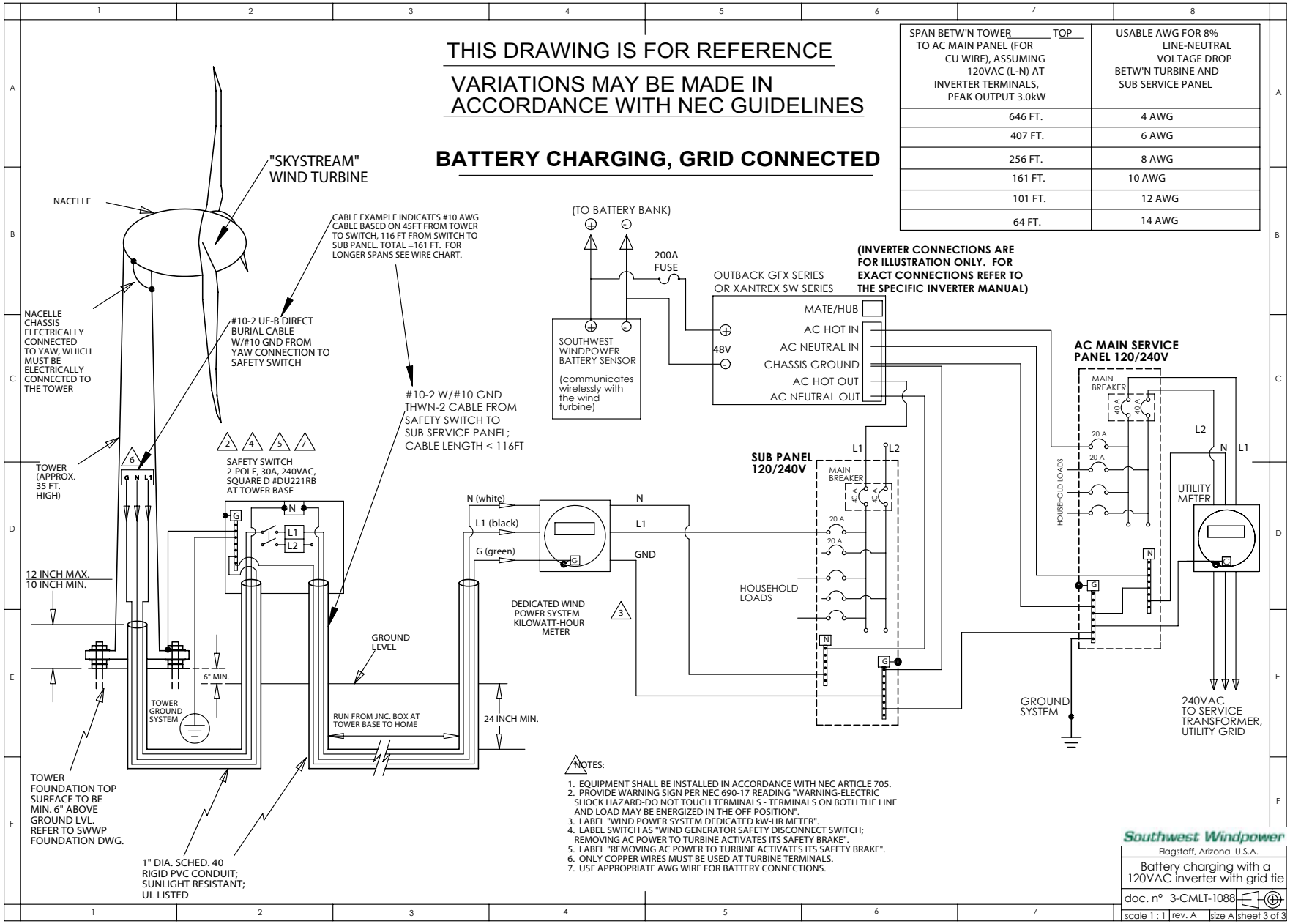
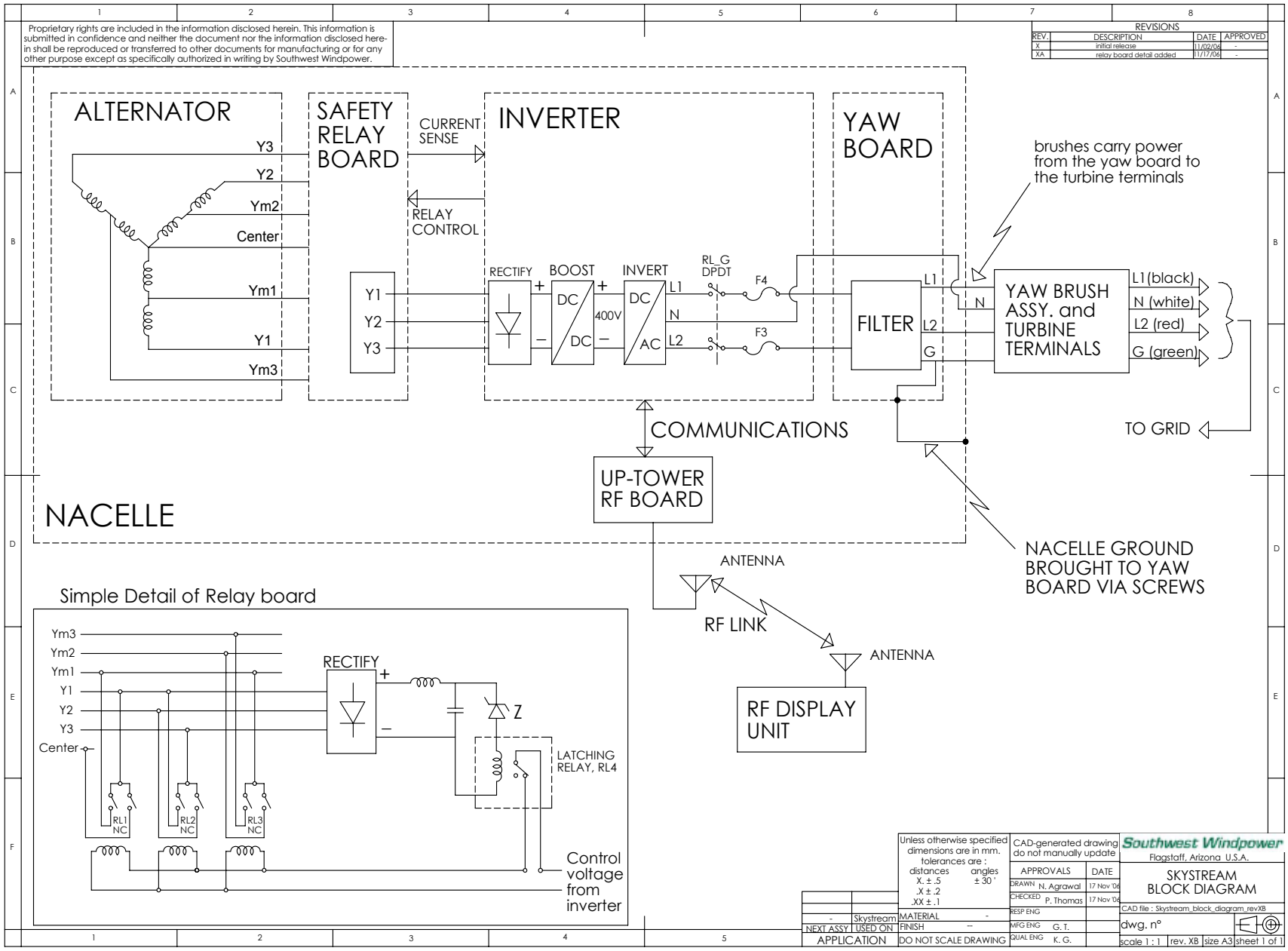
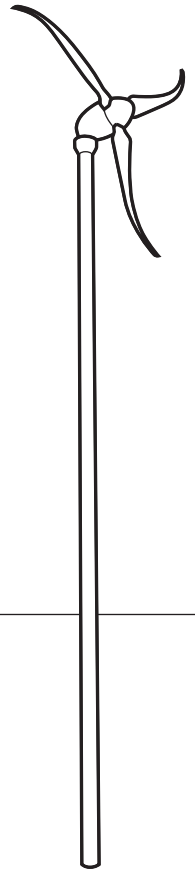

THIS DRAWING IS FOR REFERENCE
VARIATIONS MAY BE MADE IN ACCORDANCE WITH NEC GUIDELINES
BATTERY CHARGING, GRID CONNECTED
SPAN BETW'N TOWER TOP TO AC MAIN PANEL (FOR CU WIRE), ASSUMING 120VAC (L-N) AT INVERTER TERMINALS, PEAK OUTPUT 3.0kW
USABLE AWG FOR 8% LINE-NEUTRAL VOLTAGE DROP BETW'N TURBINE AND SUB SERVICE PANEL
646 FT. 4 AWG
407 FT. 6 AWG
256 FT. 8 AWG
161 FT. 10 AWG
101 FT. 12 AWG
64 FT. 14 AWG
"SKYSTREAM" WIND TURBINE
NACELLE
NACELLE CHASSIS ELECTRICALLY CONNECTED TO YAW, WHICH MUST BE ELECTRICALLY CONNECTED TO THE TOWER
CABLE EXAMPLE INDICATES #10 AWG CABLE BASED ON 45FT FROM TOWER TO SWITCH, 116 FT FROM SWITCH TO SUB PANEL. TOTAL =161 FT. FOR LONGER SPANS SEE WIRE CHART.
#10-2 UF-B DIRECT BURIAL CABLE W/#10 GND FROM YAW CONNECTION TO SAFETY SWITCH
#10-2 W/#10 GND THWN-2 CABLE FROM SAFETY SWITCH TO SUB SERVICE PANEL; CABLE LENGTH < 116FT
TOWER (APPROX. 35 FT. HIGH)
SAFETY SWITCH 2-POLE, 30A, 240VAC, SQUARE D #DU221RB AT TOWER BASE
12 INCH MAX.
10 INCH MIN.
6" MIN.
GROUND LEVEL
TOWER GROUND SYSTEM
RUN FROM JNC. BOX AT TOWER BASE TO HOME
24 INCH MIN.
TOWER FOUNDATION TOP SURFACE TO BE MIN. 6" ABOVE GROUND LVL. REFER TO SWWP FOUNDATION DWG.
1" DIA. SCHED. 40 RIGID PVC CONDUIT; SUNLIGHT RESISTANT; UL LISTED
(TO BATTERY BANK)
200A FUSE
SOUTHWEST WINDPOWER BATTERY SENSOR
(communicates wirelessly with the wind turbine)
OUTBACK GFX SERIES OR XANTREX SW SERIES
48V
(INVERTER CONNECTIONS ARE FOR ILLUSTRATION ONLY. FOR EXACT CONNECTIONS REFER TO THE SPECIFIC INVERTER MANUAL)
MATE/HUB
AC HOT IN
AC NEUTRAL IN
CHASSIS GROUND
AC HOT OUT
AC NEUTRAL OUT
AC MAIN SERVICE PANEL 120/240V
MAIN BREAKER
HOUSEHOLD LOADS
UTILITY METER
SUB PANEL 120/240V
N (white)
L1 (black)
G (green)
GND
DEDICATED WIND POWER SYSTEM KILOWATT-HOUR METER
HOUSEHOLD LOADS
GROUND SYSTEM
240VAC TO SERVICE TRANSFORMER, UTILITY GRID
NOTES:
1. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH NEC ARTICLE 705.
2. PROVIDE WARNING SIGN PER NEC 690-17 READING "WARNING-ELECTRIC SHOCK HAZARD-DO NOT TOUCH TERMINALS - TERMINALS ON BOTH THE LINE AND LOAD MAY BE ENERGIZED IN THE OFF POSITION".
3. LABEL "WIND POWER SYSTEM DEDICATED kW-HR METER".
4. LABEL SWITCH AS "WIND GENERATOR SAFETY DISCONNECT SWITCH; REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
5. LABEL "REMOVING AC POWER TO TURBINE ACTIVATES ITS SAFETY BRAKE".
6. ONLY COPPER WIRES MUST BE USED AT TURBINE TERMINALS.
7. USE APPROPRIATE AWG WIRE FOR BATTERY CONNECTIONS.
Southwest Windpower
Flagstaff, Arizona U.S.A.
Battery charging with a 120VAC inverter with grid tie
doc. n° 3-CMLT-1088
scale 1 : 1 rev. A size A sheet 3 of 3

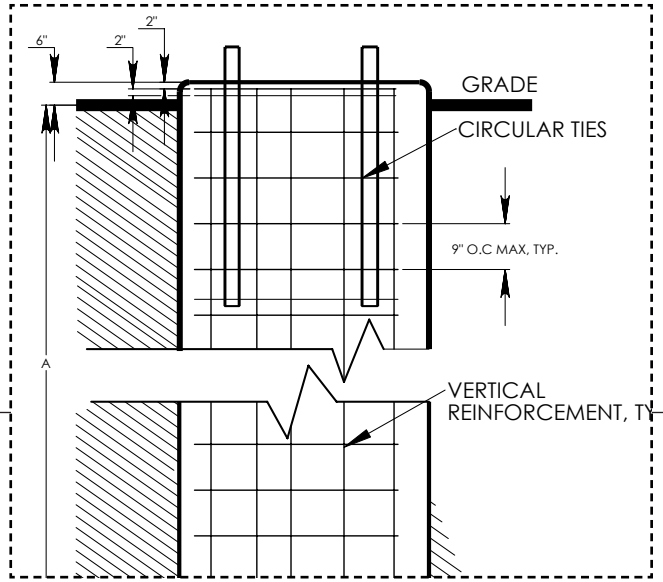
Fig. 13. Skystream Block Diagram

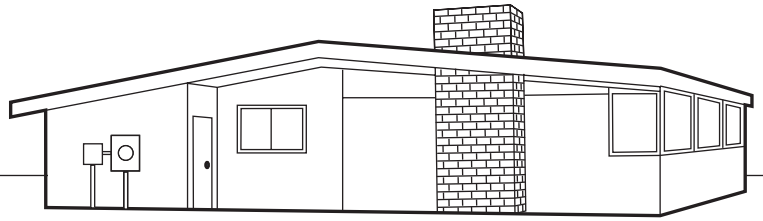


SKYSTREAM 3.7™

# APPENDIX B
# FOUNDATION INSTALLATION





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# Skystream 3.7 Owner's Manual

## Appendix B: Foundation Installation Guidelines


Important Safety Instructions ____ 3

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**1-1** Foundation Bolt Kits ____ 4

**2) PIER FOUNDATION** ____ 4

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## IMPORTANT SAFETY INSTRUCTIONS

**READ THESE INSTRUCTIONS IN THEIR ENTIRETY BEFORE INSTALLING.**

**Professional installation**
highly recommended

**1)** SAVE THESE INSTRUCTIONS. This manual contains important instructions for Skystream foundations that must be followed during installation.

**2)** Read, understand and respect all warnings.

**3)** Install Skystream foundation in accordance with National Electric Code (NEC) and local building codes.

**4)** Always obtain a building permit before construction.

**5)** When moving heavy objects to the site, use a cart to prevent back injury.

**6)** Use only proper grounding techniques as established by the NEC.

**7)** The Skystream foundation must be installed in accordance with this manual and local and national building codes. Failure to comply with the manual and local codes will affect and possibly void your warranty.

**8)** Skystream uses high voltage and is potentially dangerous. Be sure to use all safety precautions at all times.

### In this guide

**TIP:** Helpful information to ease the installation

**Professional installation**
highly recommended

**Warning:** Risk of injury or death - proceed with extreme caution

## One - Introduction

This guideline provides information for construction of foundations for the Southwest Windpower 33 ft. and 45 ft. monopole towers. Two foundation configurations – the “Pier” and “Mat” - are provided for the 33 ft. tower and two foundation configurations – the “Pier and Pad” and the “Caisson” - are provided for the 45 ft. tower.

Construction instructions are provided for the Pier and Mat (33 ft. tower) foundations. However, because of the size and complexity of the 45 ft. tower foundations Southwest Windpower strongly recommends professional construction for this foundation. Technical drawings of the 45 ft. tower foundations are provided at the end of this appendix.

Please read and understand the entire installation guideline before proceeding even if you are installing the 45 ft. tower foundation. Important information is provided regarding positioning the foundation “J” bolts, electrical conduit, and foundation bolt template.

Local building codes and regulations shall have precedence over this installation guideline.

### 1-1 Foundation Bolt Kits and Template (33 ft. and 45 ft. towers and foundations)

Two foundation bolt kits are available. The difference between the two kits is the length of the bolts. 42 inches long bolts are required for all foundations except the 33 ft. tower Mat foundation which uses 32 inch bolts. Each kit includes hot dip galvanized bolts, nuts and washers constructed of the appropriate steel alloys.

A bolt pattern template to aid in correctly positioning the bolts in the foundation is provided with the tower. A representation of the template is depicted in **Fig. B1**. The same template is used for 33 ft. and 45 ft. towers.

A typical pier foundation

## Two - Pier Foundation (33 ft. tower only)

Technical drawings for the pier foundation are presented in **Figs. B2 and B3**. The pier diameter is 24 inches (61 cm) and the depth of the pier will vary from 5 to 11 feet (1.5 m to 3.35 m) depending on soil classification. Refer to **Fig. B4** (found on pg 4 ) to determine the soil classification.

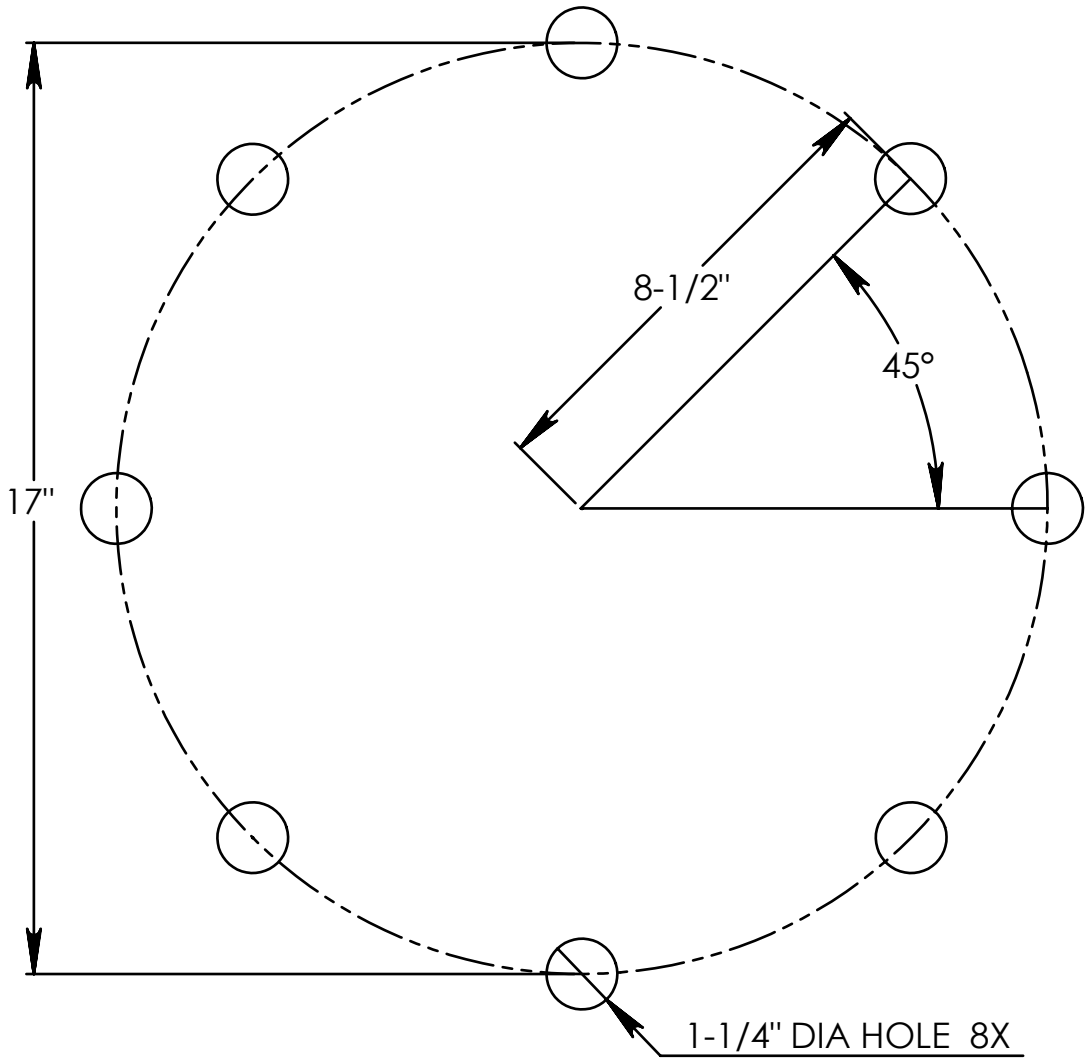


Fig. B1 Bolt template

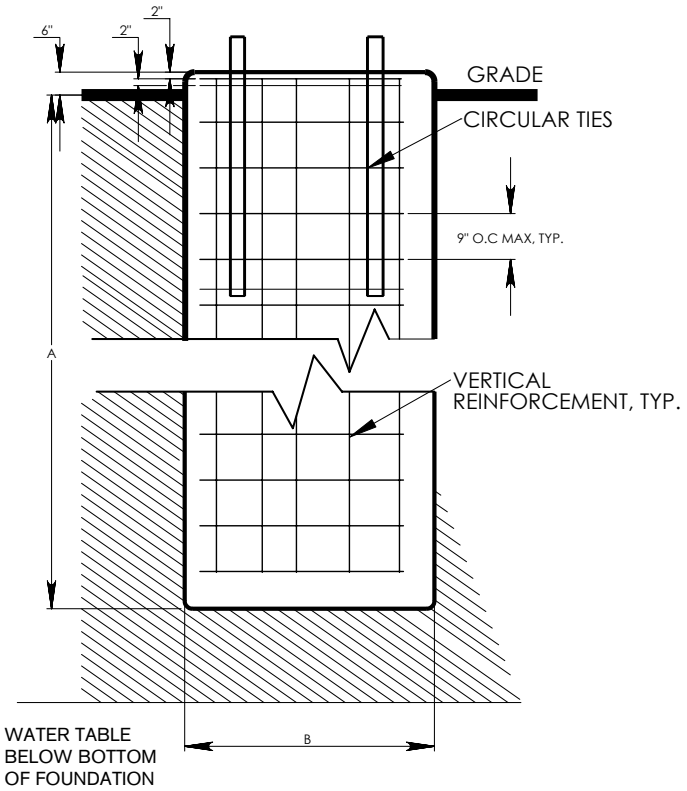


Fig. B2 Technical drawing for Pier Foundation 33 ft. Tower

**TIP:** Because special equipment is required to cut and bend the reinforcing bar it may be most economical to contract with a local concrete company to manufacture the reinforcement structure for the pier foundation.

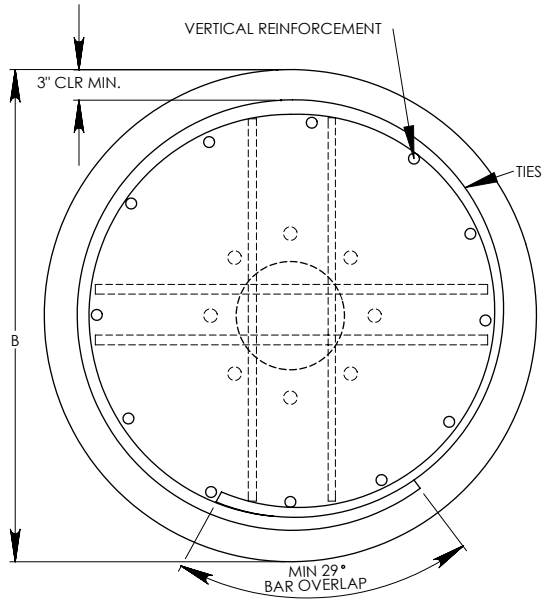


Fig.B3 Technical drawing for Pier Foundation 33 ft. Tower

| Soil Classification | | Allowable Soil Pressure | | Design Loads at Tower Base* | | | Minimum Pier Dimensions** | | | Reinforcement | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lateral | Vertical | Shear (V) | Moment (M) | Vertical (P) | Depth (A) | Diameter (B) | Projection (C ) | Vertical | Ties |
| | | psf | psf | lbs. | ft-lbs | lbs | feet | inches | inches | | |
| Class 1 | Crystalline bedrock | 1200 | 12,000 | 867 | 26,290 | 760 | 6<br>5 | 24 | 6 | (8)-#6<br>(12)-#6 | #4 @ 9" O.C. max |
| Class 2 | Sedimintary and foliated rock | 400 | 4000 | 867 | 26,290 | 760 | 8<br>7 | 24 | 6 | (8)-#6<br>(12)-#6 | #4 @ 9" O.C. max |
| Class 3 | Sandy gravel and/or gravel (GW and GP) | 200 | 3000 | 867 | 26,290 | 760 | 10<br>9 | 24 | 6 | (8)-#6<br>(12)-#6 | #4 @ 9" O.C. max |
| Class 4 | Sand , sity sand, clayey sand, sity gravel and claye gravel (SW, SP, SM, SC, GM and GC) | 150 | 2000 | 867 | 26,290 | 760 | 10 | 24 | 6 | (12)-#6 | #4 @ 9" O.C. max |
| Class 5 | Clay, sand clay, sity clay, clayey sit, silt, and sandy silt (CL, ML, MH and CH) | 100 | 1500 | 867 | 26,290 | 760 | 11<br>10 | 24<br>30 | 6 | (12)-#6 | #4 @ 9" O.C. max |

* These Are the unfactored w ind turbine extreme loads using a hub-height w ind speed of 62.9m/s (140 mph), a w ind shear of 0.20 and a tow er drag coefficient of 0.28 [ from polhamus, E.C., NASA CR 3809, 1984].

***installation of cirvular ties and anchor bols shall be in accordance w ith the draw ings.

Fig. B4 Soil Chart 33 ft. Tower

### 2-1 Forming and Reinforcing Bar (33 ft. Tower Pier Foundation)

Position reinforcing bar per **Fig. B2**. Circular ties require a minimum 29 inch (73.6 cm) overlap and a minimum 3 inch (7.62 cm) clearance from outside diameter edge of pier. Circular ties are #4 reinforcing bar with maximum 9 inch (23 cm) spacing. Vertical reinforcement bars are 12, #6 reinforcing bars equally spaced about circular ties. Forming is most easily accomplished using 24 inch (61 cm) sonotube. Forms must be removed before backfilling. The sonotube need not extend full depth of foundation if excavation is in solid undisturbed soil. See **Fig. B2**. Position 4, #6 cap bars as shown in **Fig. B2**.

### 2-2 "J" Bolts & Template (33 ft. Tower Pier Foundation)

Note: Take the time to prepare an accurate and strong template to position and secure the "J" bolts. This will save much time and difficult rework.

- Before pouring the foundation the "J" bolts **MUST** be **SECURELY** locked in position.
- A paper template is provided with the bolt kit. Use this template to drill a wood template to hold the "J" bolts in position while concrete is poured.
- Two methods of framing the "J" bolts are presented in **Fig. B4**. The first method uses a single template while the second method utilizes two templates sandwiched between lengths of 2"x4" lumber. Regardless of the method be sure bolts are correctly positioned prior to pouring concrete.
- Fabricate a wood template by securing the paper template to the wood template material (3/4" plywood works well).
- Center punch the center position of each "J" bolt. Remove the paper template and drill a 1.25 inch (3.1 cm) mounting hole for each bolt. If possible compare the template to the tower base to assure bolts will be positioned correctly.
- Mount each of the "J" bolts to the wood template by using a pair of foundation nuts to clamp the template between the nuts.
- Adjust the "J" bolts to extend 7 – 7.5 inches (17.8 cm-19.0 cm) above foundation as shown in **Fig. B4**.
- Assure all bolts are vertical and parallel.

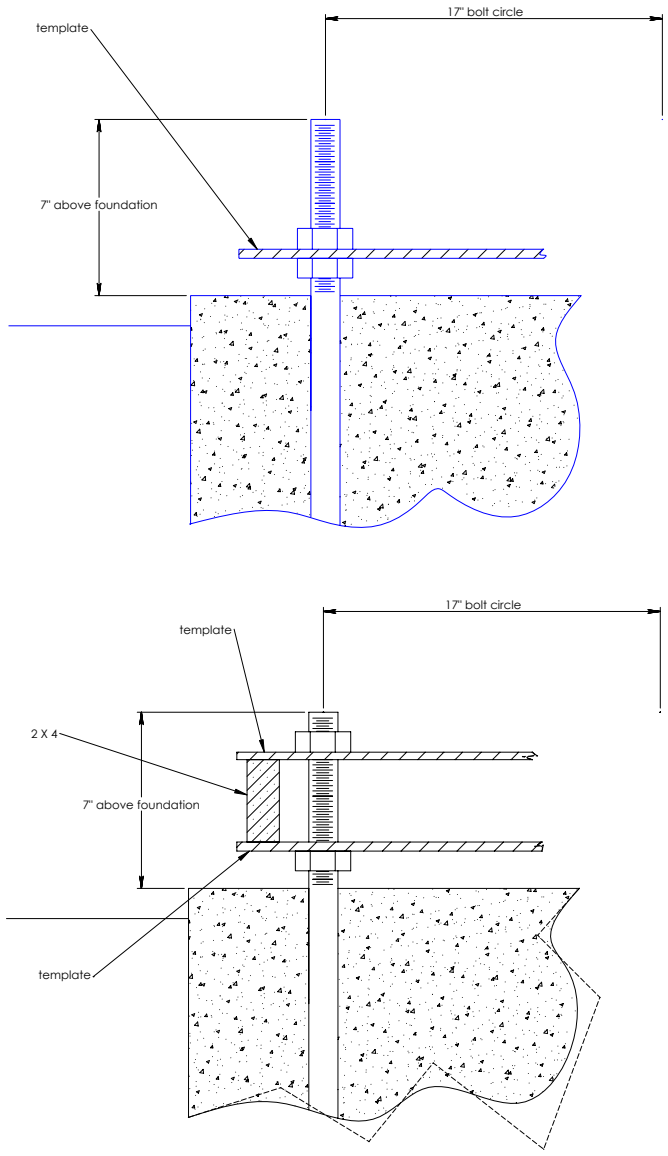


Fig. B5 “J” bolts and template (all towers)

**2-3 Pier Foundation Specifications (33 ft. tower only):**

| | |
|---|---|
| **Diameter** | 24 inches (61 cm) |
| **Depth** | Depends on soil conditions |
| **Concrete** | Minimum 2500 PSI, 28 day strength, 5% air entrapment |
| **Pier Projection Above Grade** | 6 inches (16.24 cm) |
| **Reinforcing Bar** | ASTM A615 Grade 60 |
| **Circular Ties** | #4 reinforcing bar, 17-18 inch (43 cm) diameter, 29 inch (73.6 cm) overlap |
| **Vertical Reinforcement** | 12 equally spaced #6 reinforcing bar |
| **Anchor “J” Bolts** | 42 inch (1 m) length, 1.25 inch (3.1 cm) diameter, 6 inch (16.24 cm) “J” |
| **“J” Bolt Projection Above Foundation** | 7-7.5 inches (19 cm) |

**IMPORTANT:** Do not exceed 7.5” 19.0 cm dimension or bolts may interfere with hinge plate.

## Three - MAT Foundation (33 ft. Tower only)

The MAT foundation is presented in **Fig. B6**. The foundation is a 6 foot by 6 foot (1.8 m x 1.8 m) square with a depth of 3 feet (.9 m). The MAT foundation is designed for an allowable vertical bearing pressure of 1,500 PSF (IBC Class 5 Soil per Table 1804.2).

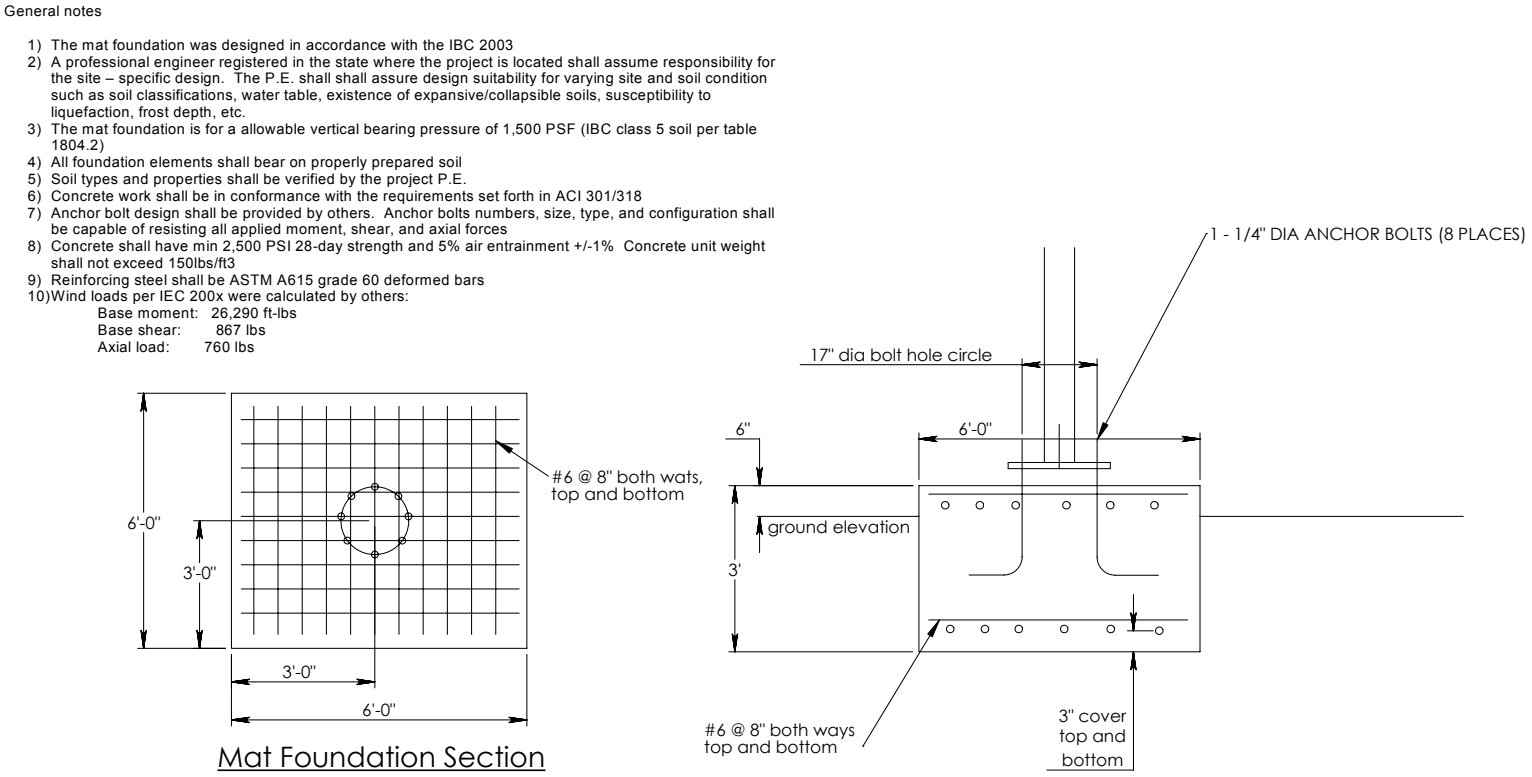
General notes
1) The mat foundation was designed in accordance with the IBC 2003
2) A professional engineer registered in the state where the project is located shall assume responsibility for the site – specific design. The P.E. shall shall assure design suitability for varying site and soil condition such as soil classifications, water table, existence of expansive/collapsible soils, susceptibility to liquefaction, frost depth, etc.
3) The mat foundation is for a allowable vertical bearing pressure of 1,500 PSF (IBC class 5 soil per table 1804.2)
4) All foundation elements shall bear on properly prepared soil
5) Soil types and properties shall be verified by the project P.E.
6) Concrete work shall be in conformance with the requirements set forth in ACI 301/318
7) Anchor bolt design shall be provided by others. Anchor bolts numbers, size, type, and configuration shall be capable of resisting all applied moment, shear, and axial forces
8) Concrete shall have min 2,500 PSI 28-day strength and 5% air entrainment +/-1% Concrete unit weight shall not exceed 150lbs/ft3
9) Reinforcing steel shall be ASTM A615 grade 60 deformed bars
10) Wind loads per IEC 200x were calculated by others:
Base moment: 26,290 ft-lbs
Base shear: 867 lbs
Axial load: 760 lbs
6'-0"
3'-0"
3'-0"
6'-0"
#6 @ 8" both wats, top and bottom
Mat Foundation Section
1 - 1/4" DIA ANCHOR BOLTS (8 PLACES)
17" dia bolt hole circle
6"
6'-0"
ground elevation
3'
#6 @ 8" both ways top and bottom
3" cover top and bottom

Fig. B6 Technical drawings for Mat Foundation

### 3-1 Reinforcing Bars (33 ft. Tower only)

Position reinforcing bar "mats" as indicated in **Fig. B6**. Reinforcing bar is #6 bar spaced at 8 inch (20.3 cm) intervals.
Reinforcing bar mats positioned with minimum 3 inch (7.6 cm) concrete cover top and bottom.

### 3-2 "J" Bolts and Template (33 ft. Tower only)

Note: Take the time to prepare an accurate and strong template to position and secure the "J" bolts. This will save much time and difficult rework.

- Before pouring the foundation the "J" bolts **MUST** be **SECURELY** locked in position.
- A paper template is provided with the bolt kit. Use this template to drill a wood template to hold the "J" bolts in position while concrete is poured.
- Two methods of framing the "J" bolts are presented in **Fig. B4**. The first method uses a single template while the second method utilizes two templates sandwiched between 2"x4" lengths of lumber. Regardless of the method be sure bolts are correctly positioned prior to pouring concrete.
- Fabricate a wood template by securing the paper template to the wood template material.
- Center punch the center position of each "J" bolt. Remove the paper template and drill a 1.25 inch (3.1 cm) mounting hole for each bolt. If possible compare the template to the tower base to assure bolts will be positioned correctly.
- Mount each of the "J" bolts to the wood template by using a pair of foundation nuts to clamp the template between the nuts.
- Adjust the "J" bolts to extend 7 – 8 inches (17.8 cm-20.3 cm) above foundation as shown in **Fig. B5**.
- Assure all bolts are vertical and parallel to each other.

### 3-3 MAT Foundation Specifications (33 ft. Tower only)

| | |
|---|---|
| **Dimensions** | 6 feet x 6 feet x 3 feet (1.8 x 1.8 x .9 m) deep |
| **Reinforcing Bar** | ASTM A615 Grade 60 |
| **Anchor "J" Bolts** | 32 inch (81.3 cm) length, 1.25 (3.1 cm) diameter, 6 inch (16.24 cm) "J" |
| **Concrete** | Minimum 2500 PSI, 28 day strength, 5% Air Entrapment |

## Four - Electrical Conduit

Electrical conduit may be cast into the foundation such that the conduit continues below grade to electrical panel. Alternately wire may be routed between tower base plate and foundation. Refer to local building codes **BEFORE** pouring concrete.

Building codes typically require direct burial cables be buried to a minimum depth of 24 inches (61 cm) while cables in conduit may be buried at a depth of 18 inches (46 cm). Additionally, most codes prohibit embedding cables directly in concrete. Refer to local codes for conduit size and minimum depth requirements.

**Note:** Space between foundation and bottom of tower base plate should be filled with high strength non-shrink grout after final positioning of tower on foundation.

45 ft. Tower Notes

## REINFORCING STEEL NOTES:

1. THE REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM A-615, GRADE 60. IT SHALL BE DEFORMED AND SPLICES SHALL NOT BE ALLOWED UNLESS OTHERWISE NOTED.
2. WELDING IS PROHIBITED ON REINFORCING STEEL AND EMBEDMENTS.
3. REINFORCING CAGES SHALL BE BRACED TO RETAIN PROPER DIMENSIONS DURING HANDLING AND THROUGHOUT PLACEMENT OF CONCRETE. WHEN TEMPORARY CASING IS UTILIZED, BRACING SHALL BE ADEQUATE TO RESIST FORCES OCCURRING FROM FLOWING CONCRETE DURING CASING EXTRACTION.
4. SPACERS SHALL BE ATTACHED INTERMITTENTLY THROUGHOUT THE ENTIRE LENGTH OF TIEBACK REINFORCING TO INSURE CONCENTRIC PLACEMENT OF CAGES IN EXCAVATIONS.
5. MINIMUM CONCRETE COVER FOR REINFORCEMENT SHALL BE 3" UNLESS OTHERWISE NOTED. APPROVED SPACERS SHALL BE USED TO INSURE A 3" MINIMUM COVER ON REINFORCEMENT.

## CONCRETE NOTES:

1. WORK SHALL BE IN ACCORDANCE WITH THE LATEST REVISION OF THE ACI-318, "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE."
2. THE CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI IN 28-DAYS.
3. PROPORTIONS OF CONCRETE MATERIALS SHALL BE SUITABLE FOR THE INSTALLATION METHOD UTILIZED AND SHALL RESULT IN DURABLE CONCRETE FOR RESISTANCE TO LOCAL ANTICIPATED AGGRESSIVE ACTIONS. THE DURABILITY REQUIREMENTS OF ACI-318 SHALL BE SATISFIED BASED ON THE CONDITIONS EXPECTED AT THE SITE.
4. CONCRETE SHALL BE PLACED IN A MANNER THAT WILL PREVENT SEGREGATION OF CONCRETE MATERIALS, INFILTRATION OF WATER OR SOIL, AND OTHER OCCURRENCES THAT MAY DECREASE THE STRENGTH OR DURABILITY OF THE FOUNDATION.

## TOWER REACTIONS

| MOMENT (Ft-Kips) | SHEAR (Kips) | VERTICAL (Kips) |
|---|---|---|
| 40.1 | 1.08 | 0.9 |

NORTH CAROLINA PROFESSIONAL SEAL 032002 ENGINEER MICHAEL L. GARDNER
February 14, 2007

## CONCRETE NOTES (CONTINUED):

5. FREE FALL CONCRETE MAY BE USED PROVIDED FALL IS VERTICAL DOWN WITHOUT HITTING THE SIDES OF THE EXCAVATION, FORMWORK, REINFORCING BARS, FORM TIES, CAGE BRACING, OR OTHER OBSTRUCTIONS. UNDER NO CIRCUMSTANCES SHALL CONCRETE FALL THROUGH WATER.
6. THE MAXIMUM SIZE OF THE AGGREGATE SHALL NOT EXCEED A SIZE SUITABLE FOR THE INSTALLATION METHOD UTILIZED OR 1/3-CLEAR DISTANCE BEHIND OR BETWEEN REINFORCING. THE MAXIMUM SIZE MAY BE INCREASED TO 2/3-CLEAR DISTANCE PROVIDED WORKABILITY AND METHODS OF CONSOLIDATION SUCH AS VIBRATING WILL PREVENT HONEYCOMBS AND VOIDS.

## NOTE:

THE FOUNDATION DESIGNS WERE BASED ON SOIL INFORMATION LISTED IN THE TABLE BELOW. IT IS THE RESPONSIBILITY OF THE OWNER TO VERIFY BY GEOTECHNICAL INVESTIGATION THAT ACTUAL SITE SOIL PARAMETERS EQUAL OF EXCEED THOSE SHOWN IN THE TABLE BELOW. IF CONDITIONS OTHER THAN THOSE DESCRIBED IN THE TABLE BELOW ARE ENCOUNTERED A FOUNDATION ANALYSIS SHOULD BE PERFORMED TO DETERMINE THE STRUCTURAL ADEQUACY OF THE SUBSTRUCTURE.

## ALLOWABLE FOUNDATION AND LATERAL PRESSURE

| SOIL CLASS | DESCRIPTION | ALLOWABLE FOUNDATION PRESSURE (PSF) | LATERAL BEARING (PSF/FT BELOW NATURAL GRADE) | LATERAL SLIDING | |
|---|---|---|---|---|---|
| | | | | COEFF. OF FRICTION | RESISTANCE (PSF) |
| 1 | CRYSTALLINE BEDROCK | 12,000 | 1,200 | 0.70 | – |
| 2 | SEDIMENTARY AND FOLIATED ROCK | 4,000 | 400 | 0.35 | – |
| 3 | SANDY GRAVEL AND/OR GRAVEL (GW AND GP) | 3,000 | 200 | 0.35 | – |
| 4 | SAND, SILTY SAND, CLAYEY SAND, SILTY GRAVEL, AND CLAYEY GRAVEL (SW,SP,SM,SC,GM AND GC) | 2,000 | 150 | 0.25 | – |
| 5 | CLAY, SANDY CLAY, SILTY CLAY, CLAYEY SILT, SILT AND SANDY SILT (CL, ML, MH AND CH) | 1,500 | 100 | – | 130 |

TOWER ENGINEERING PROFESSIONALS
3703 JUNCTION BOULEVARD
RALEIGH, NC 27603-5263
(919) 661-6351

PROJECT INFORMATION:
**45' MONOPOLE FOUNDATIONS**

*Southwest Windpower*
Renewable Energy Made Simple
1801 West Route 66
Flagstaff, AZ 86001
Office: (928) 779-9463

| REV | DATE |
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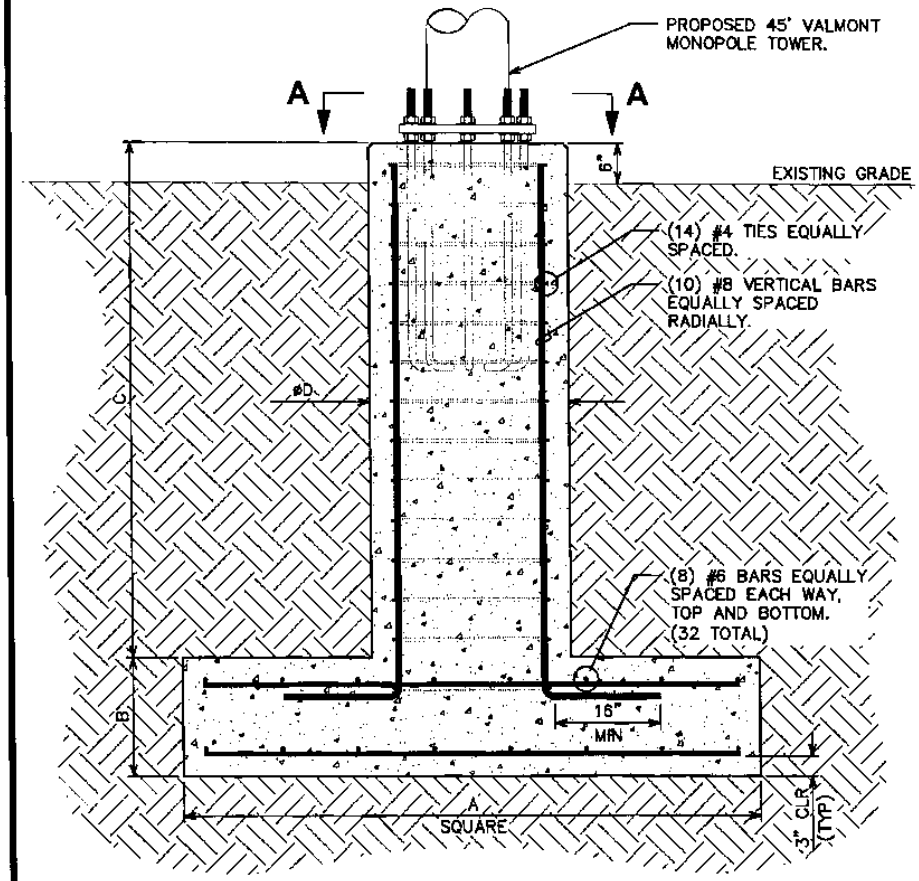
| 0 | 02-14-07 |

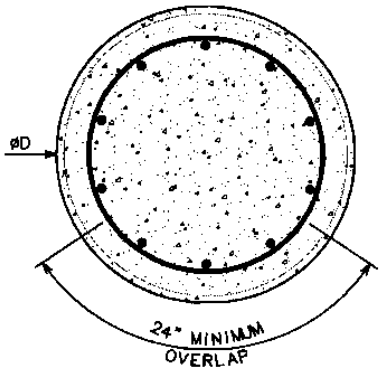
DRAWN BY: WHM | CHECKED BY: MLG

SHEET NUMBER: **S-1**

REVISION: 0

TEP #: 070175




## SECTION A-A

SCALE: ¾" = 1'-0"

NORTH CAROLINA PROFESSIONAL SEAL 032002 ENGINEER MICHAEL L. GARDNER
February 14, 2007

## FOUNDATION DIMENSIONS

| SOIL CLASS | A | B | C | D |
|---|---|---|---|---|
| 1 | – | – | – | – |
| 2 | – | – | – | – |
| 3 | 8'–6" | 1'–6" | 4'–6" | 2'–6" |
| 4 | 8'–9" | 1'–6" | 4'–6" | 2'–6" |
| 5 | 9'–0" | 1'–6" | 4'–6" | 2'–6" |

## NOTE:

1. IF FROST LINE IS KNOWN TO BE GREATER THAN THE FOUNDATION DEPTH OR WATER TABLE IS LESS THAN THE FOUNDATION DEPTH, THE DESIGN ENGINEER SHALL BE NOTIFIED PRIOR TO CONSTRUCTION.

## FOUNDATION ALTERNATIVE I - PAD AND PIER

SCALE: N.T.S.

TOWER ENGINEERING PROFESSIONALS
3703 JUNCTION BOULEVARD
RALEIGH, NC 27603-5263
(919) 661-6351

PROJECT INFORMATION:
**45' MONOPOLE FOUNDATIONS**

*Southwest Windpower*
Renewable Energy Made Simple
1801 West Route 66
Flagstaff, AZ 86001
Office: (928) 779-9463

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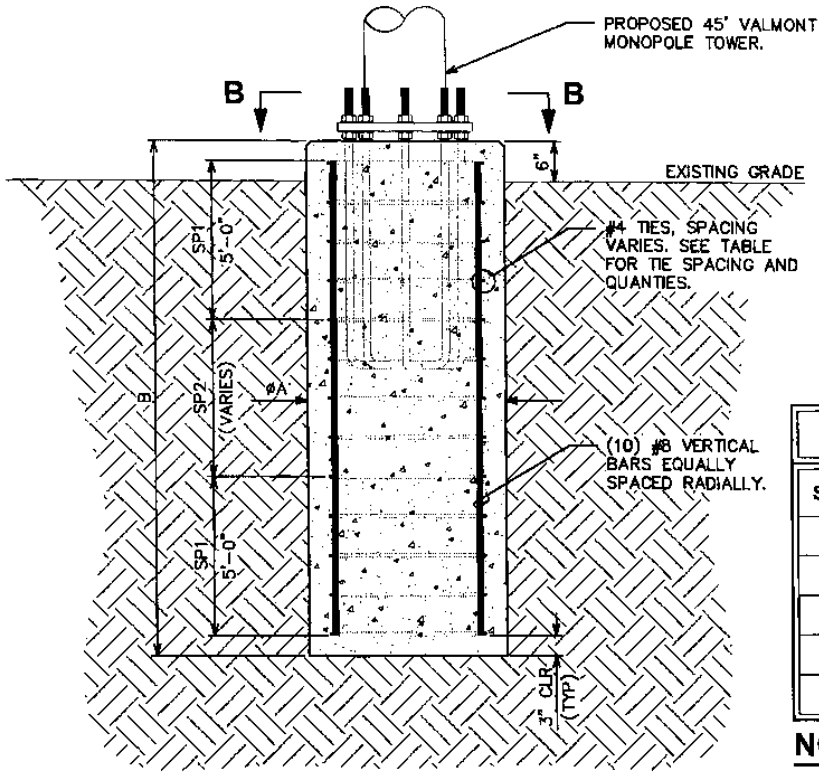
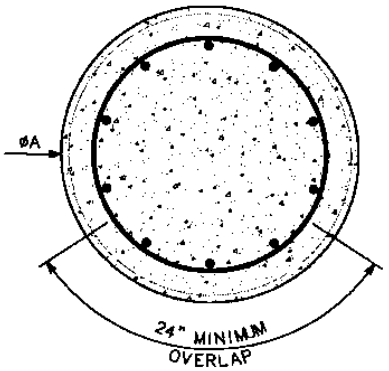
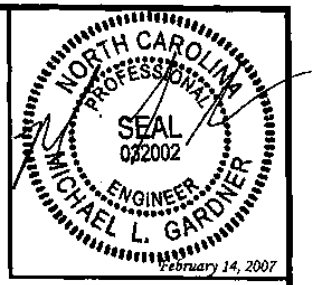
SHEET NUMBER: **S-2**

REVISION: 0

TEP #: 070175




## SECTION B-B

SCALE: ¾" = 1'-0"

### FOUNDATION DIMENSIONS

| SOIL CLASS | A | B | SP1 | SP2 | #4 TIE (QUANTITY) |
|---|---|---|---|---|---|
| 1 | 2'-6" | 5'-0" | 6" O.C. | – | 10 |
| 2 | 2'-6" | 6'-6" | 6" O.C. | – | 13 |
| 3 | 2'-6" | 10'-6" | 6" O.C. | – | 21 |
| 4 | 2'-6" | 12'-6" | 6" O.C. | 6" O.C. | 25 |
| 5 | 2'-6" | 18'-5" | 6" O.C. | 12" O.C. | 29 |

## NOTE:

1. IF FROST LINE IS KNOWN TO BE GREATER THAN THE FOUNDATIONS DEPTH OR WATER TABLE IS LESS THAN THE FOUNDATION DEPTH, THE DESIGN ENGINEER SHALL BE NOTIFIED PRIOR TO CONSTRUCTION.

## FOUNDATION ALTERNATIVE II - CAISSON

SCALE: N.T.S.

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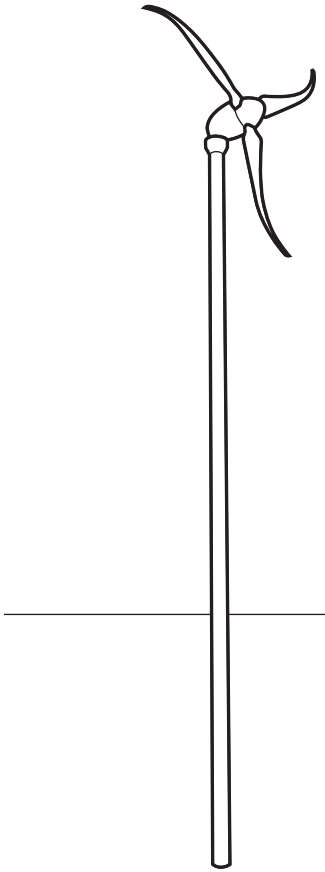
REVISION: 0

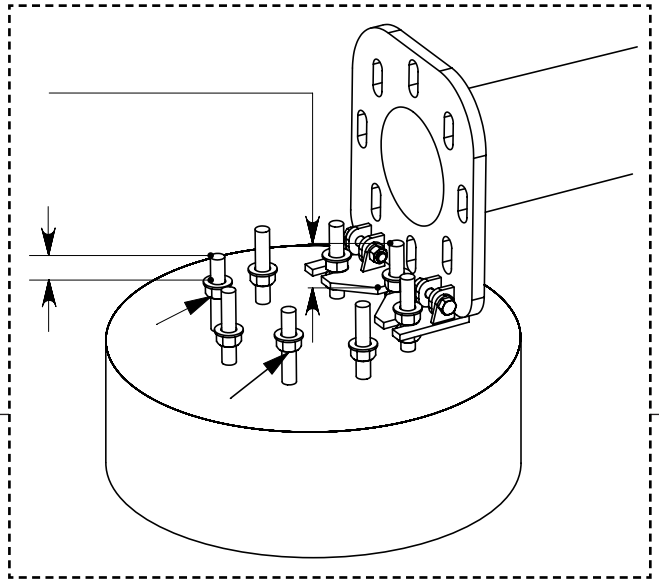
TEP #: 070175

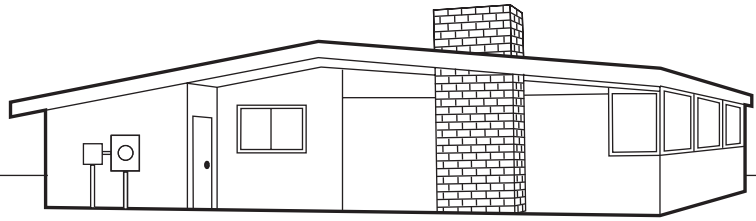
SKYSTREAM 3.7™

# APPENDIX C
# 33 FT. TOWER INSTALLATION

**Skystream Monopole Towers**







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**www.skystreamenergy.com**

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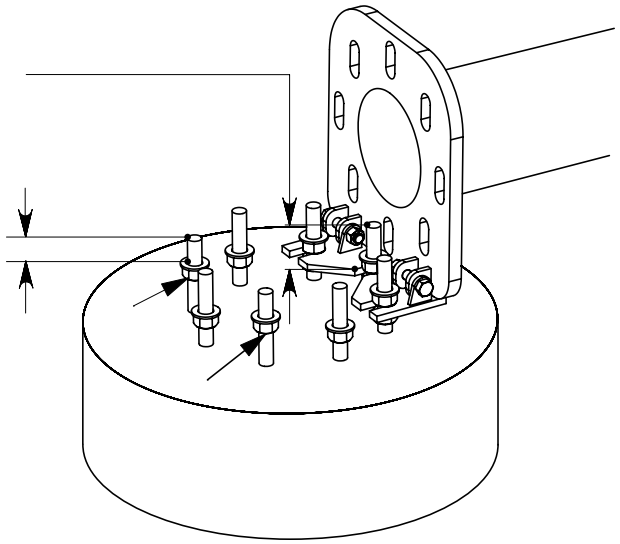

# Skystream 3.7 Owner's Manual

## Appendix C: Skystream 33 Ft. Tower Installation Instructions


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**2) SET UP & PREPARATION** ____ 5-8

**3) RAISING THE TOWER** ____ 9

**4) LOWERING THE TOWER** ____ 10

**5) LEVELING THE TOWER** ____ 11

## IMPORTANT SAFETY INSTRUCTIONS

**READ THESE INSTRUCTIONS IN THEIR ENTIRETY BEFORE INSTALLING.**

**Professional installation**
highly recommended

1) SAVE THESE INSTRUCTIONS. This manual contains important instructions for raising, lowering and leveling the tower that must be followed.
2) Read these instructions in their entirety before beginning the installation.
3) Be extremely careful of overhead power lines.
4) Do not start installation unless all required equipment and tools are on site.
5) Foundation concrete must be completely cured. (Minimum 2500 PSI, 28 day strength)
6) Install tower in accordance with local zoning and building codes. Obtain all necessary building permits PRIOR to installation.
7) Remain at a safe distance when raising and lowering the tower. Do not walk or stand under the tower and keep clear of cables.

In this guide

**TIP:** Helpful information to ease the installation

**Professional installation**
highly recommended

**Warning:** Risk of injury or death - proceed with extreme caution

## One - Introduction

The following instructions provide specific installation directions for Southwest Windpower's 33 ft. monopole tower. Installation requires use of the Hinge and Gin Pole Kits, which were specifically designed for this application. Additionally, these instructions assume a bolt kit was purchased and the correct foundation nuts, bolts and washers are available.

Once the tower is raised into position the hinge and gin pole are removed. It is therefore not necessary to purchase these items. Should it be necessary to lower the tower, the hinge and gin pole may be reinstalled and used to lower and raise the tower.

### 1-1 Required Tools & Equipment

The following tools and equipment are necessary to install the tower:

- Hinge Mounting Kit - Part Number 3-CMBP-3063
- Gin Pole Kit - Part Number 3-CMBP-3054
- 16 Flat Washers, 1 1/4" ID, galvanized SATM F436, (SWWP part number 3-HDWA-917)
- 19 Nuts, 1 1/4", galvanized, (SWWP part number 3-HDNT-908)
- Bubble level, (easier with two levels)
- Pair of 2" open end wrenches.
- Pair of adjustable wrenches to install hinge plates and gin pole, tape measure.

## Two - Set Up & Preparation

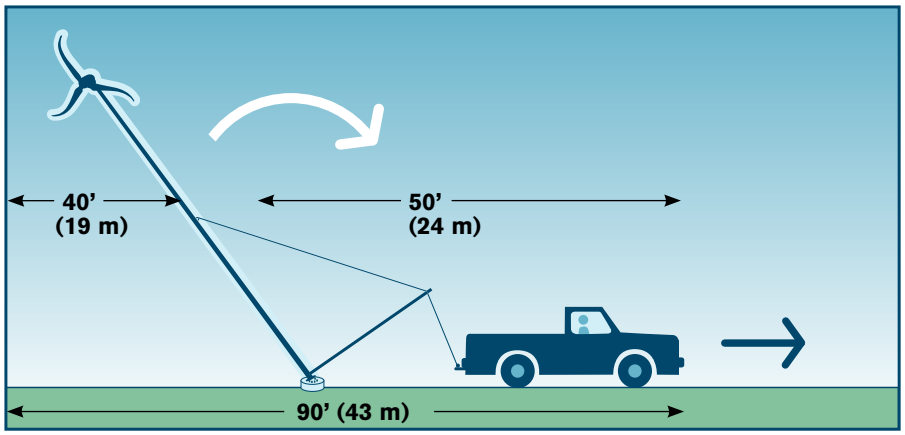



Fig. 1C

**TIP:** Approximately 90 feet (43 meters) are required to raise the tower vertically into position. Forty feet (19 meters) are required on one side of the foundation for the tower and wind generator. An additional 50 feet (24 meters) are required on the other side of the foundation for the gin pole and pulling vehicle. See **Fig. 1C**.

**TIP:** The 5” adjustment is temporary. The height of the hinge must be adjusted as described in latter instructions.

Carefully read and perform the following steps to prepare for raising the tower.

- Determine the three foundation bolts to be used to mount the hinge. The hinge is installed in the direction the tower will be “tilted down”. Refer to **Fig. 2C**.
- Screw a 1 1/4” nut on each of the three foundation bolts that will be used to mount the tower hinge. Thread the nuts down so the top of the nut is approximately 5” (13 cm) from the top of the foundation bolt. Refer to **Fig. 2C**.
- Screw a 1 1/4” nut on each of the eight foundation bolts. The foundation bolts used to mount the hinge will have two nuts. Leave a gap of approximately 7/8” (2 cm) between the nuts to accommodate the hinge.
- Bolt the hinge to the tower base plate using the 7/8” x 5 1/2” bolts and nuts supplied with the hinge kit. Fully screw the nuts onto the bolts. The bolts act as hinge pins, therefore, it is not necessary to overly tighten the nuts on the bolts.
- Using suitable lifting equipment, lift the tower base (with hinge) and position the hinge slots between the nuts on the foundation bolts. Refer to **Fig. 2C**.

- Tighten the hinge plate nuts such that the top of the hinge plate is 4 1/4" (10.8 cm) from the top of the foundation bolts.

**WARNING:** The 4 1/4" height adjustment is VERY important to insure the foundation bolts will clear the slotted holes in the base plate allowing the tower to fully tilt into position.

- Adjust the remaining nuts as shown in **Fig. 2C**. The "A" and "B" nuts should be adjusted such that 2 1/4" (5.7 cm) of the bolt extends above the washer. The remaining three nuts should be adjusted lower than the "A" and "B" nuts. These nuts will be tightened after leveling the tower.

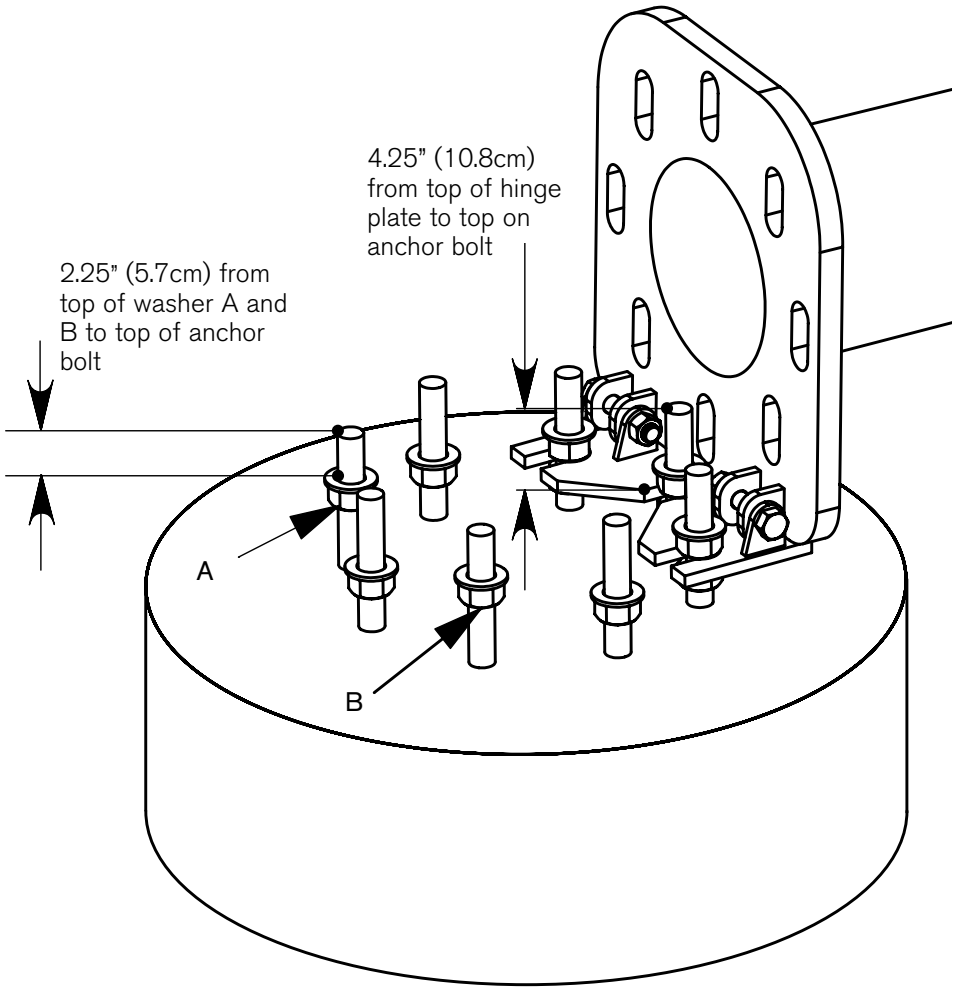



Fig. 2C Hinge assembly and nut placement.

**Gin Pole Instructions**

There are two versions of the Gin Pole kit, the “early” and “late” versions as indicated in the figures below. The installation instructions for each version differ slightly. Where required the directions indicate specific instructions for either the “early” or “late” version gin pole kit.

**TIP:** The tower is now set to be raised. Southwest Windpower recommends raising the tower once without the wind turbine installed. This permits checking the proper operation and installation of the hinge and gin pole and also allows inexperienced installers an opportunity to practice raising the tower without risking damage to the wind turbine.

Early Version Kit

- two cables
- two shackles
- two M16 (metric 16 mm) bolts
- two M16 nuts
- three M24 (metric 24 mm) bolts
- three M24 nuts

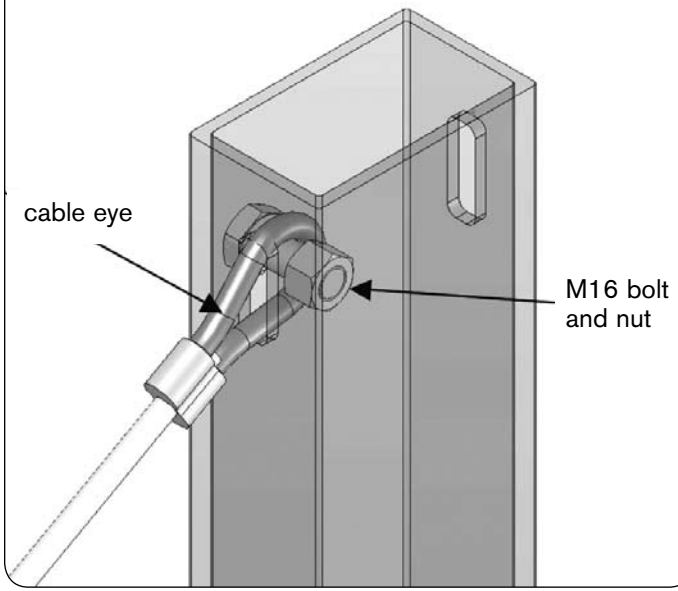



Fig. 3C Eary Version cable-gin pole assembly details

Late Version Kit

- gin pole
- two cables
- three shackles
- one M16 (metric 16 mm) bolt
- one M16 nut
- three M24 (metric 24 mm) bolts
- three M24 nuts

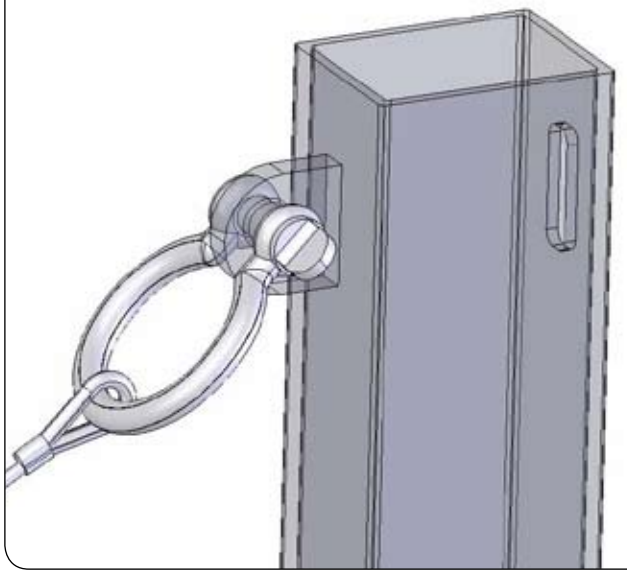


Fig. 4C Late Version cable-gin pole assembly details

- Connect the gin pole to the tower base on the opposite side of the tower hinge. Use three 24 mm nuts and bolts. The nuts only need to be hand tight.

**TIP:** Install 24 mm gin pole bolts from above so they can be removed after tower is tilted into position.

- Early and Late model gin poles – using a 16 mm nut and bolt connect one cable end to the gin pole as shown in **Fig 3C**. Connect the other end of the cable to the welded tab on the tower using one of the supplied shackles.
- Early model gin pole only – connect the second cable to the gin pole using a 16 mm nut and bolt as depicted in **Fig 3C**.
- Late model gin pole only – connect the second cable to the welded tab on the gin pole using a shackle as shown in in **Fig 4C**.
- Early and Late model gin poles – connect loose end of second cable to raising vehicle using one of supplied shackles.

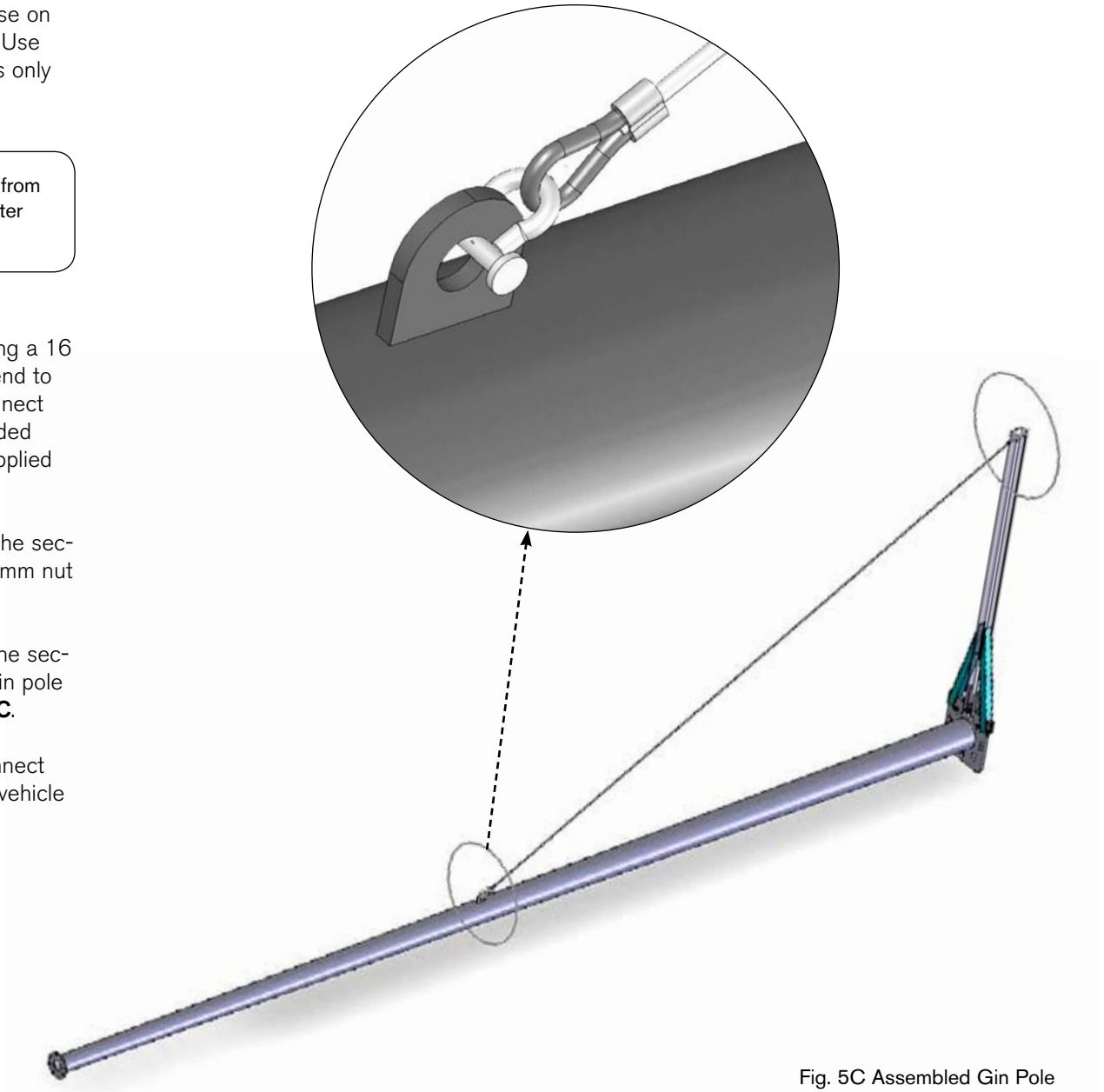


Fig. 5C Assembled Gin Pole

## Three - Raising the Tower

Refer to your Skystream Owner's Manual for directions on mounting Skystream on the tower. If you have not raised a tower before it is also recommended to first raise the tower without the turbine. Raising the tower without the turbine provides the opportunity to practice the procedure without risking damage to the turbine.

A minimum of three people are required to raise the tower.

- Position the remainder of tower mounting hardware and tools close to the tower foundation.
- Securely connect the gin pole cable to the raising vehicle.
- Very slowly, drive the vehicle away from the tower taking the "slack" out of the cable. Keep the vehicle inline with the tower while slowly raising the tower.

**WARNING:** Use extreme caution when raising the tower. Keep well away and to sides of tower and cable. Beware of overhead power lines.

- As the tower approaches vertical it will reach a "balance point". At this point two people can take over from the vehicle and use the gin pole to manually "lower" the tower into the full upright position. The goal is to prevent the tower from "falling" into the final vertical position after it passes the "balance point".
- With the tower vertical and resting on the foundation bolts, install the remaining nuts and washers and hand tighten the nuts. Note that the tower may be tilted away from the hinge and it may be necessary to lower the "hinge side" of the tower to fully thread the nuts on the foundation bolts.
- If the tower was raised without the wind turbine, refer to the Lowering the Tower section and follow the instructions. If the tower was raised with the wind turbine proceed to Leveling the Tower section.

## Four - Lowering the Tower

Lowering the tower is essentially the reverse of raising the tower. The same precautions should be observed, including positioning the hinge so the tower base plate clears the foundation bolts. As with raising the tower a minimum of three people are recommended.

**WARNING:** Use extreme caution when lowering the tower. Keep well away and to sides of tower and cable.

- Position suitable bracing support the top of the tower after it is lowered. The support should be located approximately 8 feet (2.5 m) from the top of the tower to clear the turbine blades.
- If not already in place, install the hinge plate by sliding the hinge between the lower and middle nuts on the foundation bolts. Slide the 7/8" diameter bolts that act as hinge pins through the hinge and tower foundation plate and snuggly tighten the 7/8" nuts.
- Securely tighten the 1 1/4" nuts that secure the hinge to the foundation bolts. Check the distance from the top of the hinge to the top of the foundation bolts is 4 1/4". Adjust if necessary. Refer to **Fig. 2C**.
- Bolt the gin pole to the foundation plate and connect the cable from gin pole to the weldment on the tower.
- Connect the second cable to the gin pole and lowering vehicle.
- Position the vehicle so it is in line with the tower and there is approximately 1 foot (30 cm) of slack in the gin pole cable.
- Remove the remaining 1 1/4" nuts and washers from the foundation bolts.
- The lowering process is started by two people lifting the gin pole so that the tower starts to tilt and takes up the cable slack.
- Once the tower passes the balance point the the vehicle can then be used to fully lower the tower.

**WARNING:** Someone MUST be in the vehicle at all times to control lowering the tower. The "pulling" force the tower exerts greatly increases as the tower approaches the horizontal. In other words the tower is lowered using the vehicle brakes to slow the descent of the tower. During lowering keep the vehicle engine running to provide power brake assistance.

## Five - Leveling the Tower

Leveling the tower is most easily accomplished using only four of the eight foundation bolts. Once the tower is leveled the remaining bolts can be fully tightened to secure the tower.

Be aware that leveling the tower may require some trial and error adjustments – even though the base is level, the upper tower flange may be off level due to manufacturing tolerances.

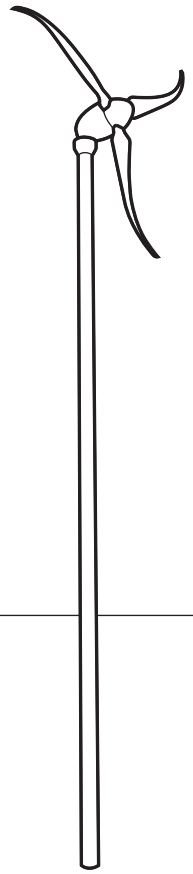
To level the tower:

- Level the tower on a calm day to minimize movement of Skystream. Start by loosening all the upper foundation nuts about a full turn.
- Loosen and lower the four nuts on the "sides" of the foundation base plate. In other words the tower should be supported by the four "corner" nuts of the tower base plate. (refer to **Fig. 2C**, Bolts A and B are "corner" bolts)
- Using two bubble levels set perpendicular to each other on the base plate adjust the foundation nuts until the tower is level. Magnetic bubble levels may make this process easier.
- Once the tower is level tighten all nuts and recheck level.

Observe the position of Skystream on calm days. If the wind turbine seems to favor a single position with no wind, the tower may require fine tuning even if it appears level using the bubble leveling technique.

To fine tune the tower realize that the nose cone of the wind turbine will "point" in the direction of the tower low side. Therefore, to level the tower, slightly raise the side of the tower under the nose cone or lower the side of the tower opposite the nose cone. Make fine adjustments. Approximately one turn of a foundation nut equates to slightly more than 1/8" (6.4 mm) so even a half turn adjustment will make a difference.

SKYSTREAM 3.7™



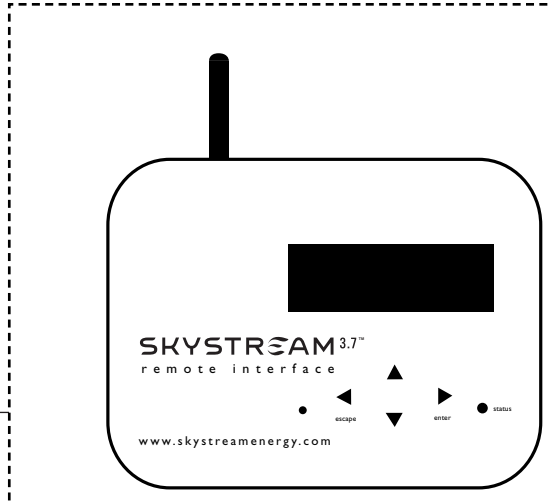
# APPENDIX D
# INTERFACE & SOFTWARE

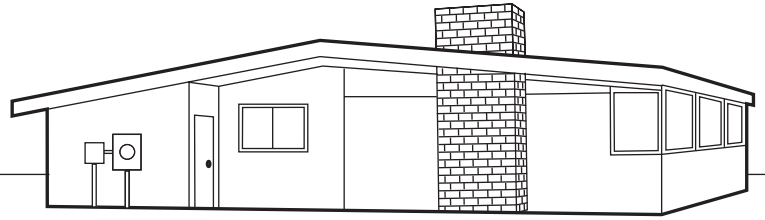
**Wireless Remote Display**

**USB Converter**

**Battery Sensor Setup**

**DataLogger Software**



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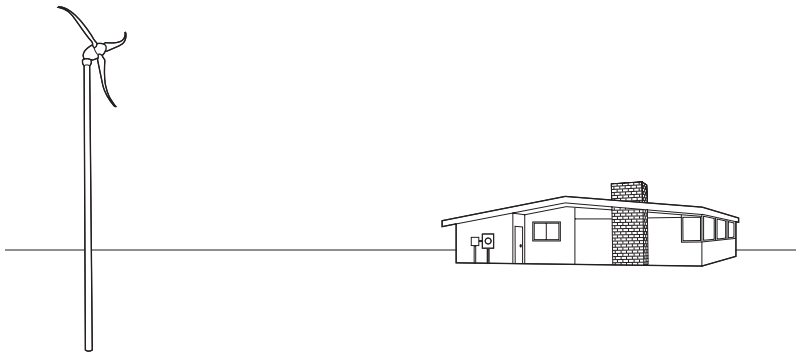

Skystream 3.7 Interface and Software Guide
Document No. 0341
Revision: B

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## ONE - USING THE WIRELESS REMOTE DISPLAY

### 1-1 INTRODUCTION

The Skystream 3.7 Wireless Remote Display provides two-way communication with the Skystream 3.7 wind turbine. The Wireless Remote Display receives information from Skystream and presents it on the display panel. The Wireless Remote Display may also be used to transmit commands and information to Skystream. Skystream may be turned on or off via the Wireless Remote Display. Additionally, it will be possible to upload newer Skystream operational software without removing Skystream from the tower.

### 1-2 CONTROLS

Operation of the Wireless Remote Display is easy and intuitive. Text and numerical information is displayed through the LCD display and a LED indicator provides status information. Input and control is accomplished by means of four push buttons that provide these functions:

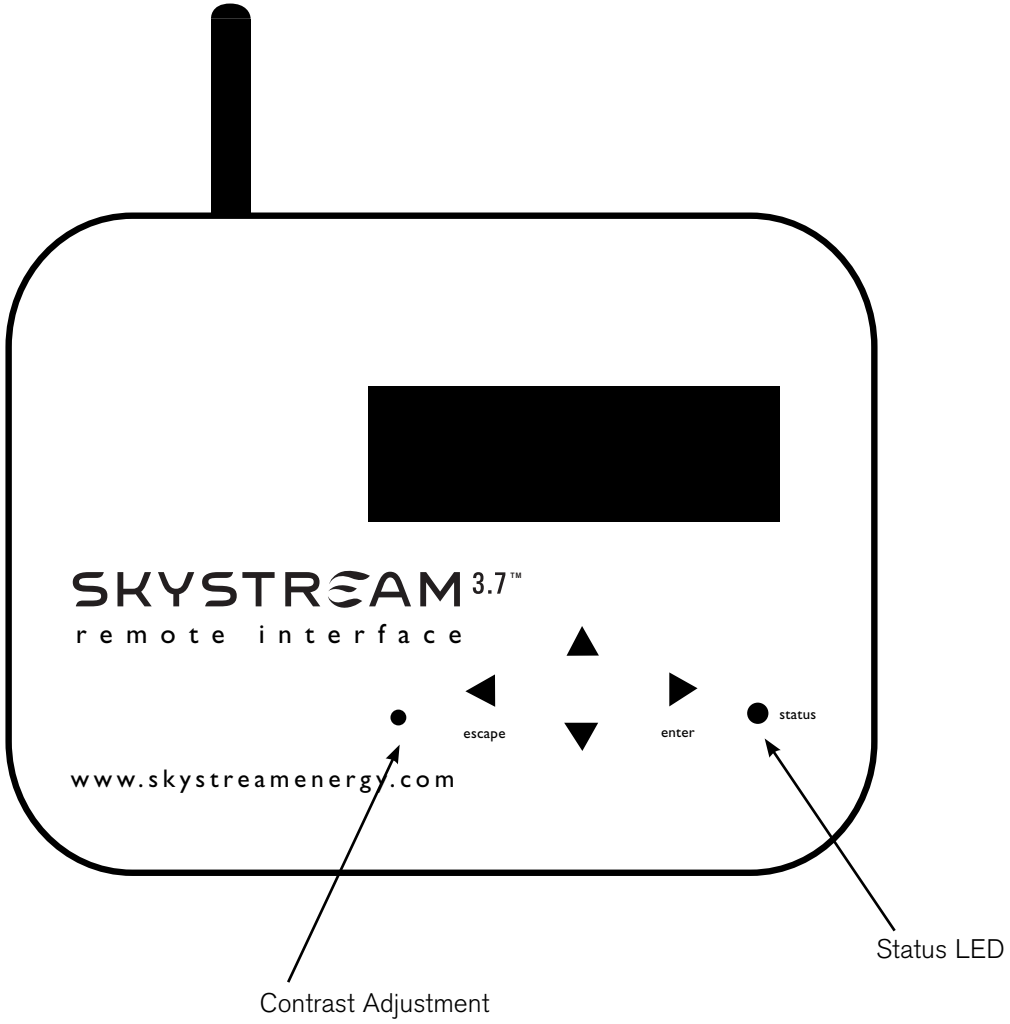
Scroll Up ⏫

Scroll Down ⏬

Escape ⏪

Enter ⏩

Refer to image at right.



## 1-3 OPERATION

Upon powering the Wireless Remote Display the Main Menu is displayed as shown below:

**MAIN MENU**

- ➔ Device Settings
- ➔ Monitor Turbine
- ➔ Control Turbine

A complete “Map” of menus and menu selections is presented below as an “indented” list. Navigate to the desired selection using the ⊙ and ⊙ buttons to scroll up or down and then depress Enter ⊙ or Escape ⊙ to make a selection or back up. Each selection is described in the sections following the indented map.

**MAIN MENU**

- ➔ **Device Settings**
  - ➔ SETTINGS MENU
  - ➔ Units: INTL STANDARD or US CUSTOMARY
  - ➔ Select Turbine
    - ➔ Enter turbine serial number:
  - ➔ Wireless Settings
    - ➔ WIRELESS MENU
      - ➔ Channel : 0 to 4
      - ➔ Mode: Active or Passive
      - ➔ Extra devices: Yes or No
- ➔ **Monitor Turbine**
  - ➔ Regulate: X.XXX % or Running or Normal
  - ➔ Pwr: 0000 W RPM: XXX
  - ➔ Tmp: XXX.X V: X.XX
  - ➔ Batt: XXX.X V RF: V1.01
- ➔ **Control Turbine**
  - ➔ SET EVALUATION
  - ➔ Turbine on
  - ➔ Turbine off

**1-4 DEVICE SETTINGS**

Selecting “Device Settings” from the MAIN MENU causes the SETTINGS MENU to be displayed. The SETTINGS MENU and each selection are described below.

**SETTINGS MENU**

➜ Units: US CUSTOMARY or INTL STANDARD
Select Turbine
Wireless Settings

**Units: US CUSTOMARY or INTL STANDARD**
This selection causes measurements to be displayed in either US CUSTOMARY or INTL STANDARD units. Make selection using the Enter ⊙ key. Selection is enabled using the Escape ⊙ key.

**Select Turbine:**
This selection permits inputting the Skystream serial number or in the case of multiple turbine installations up to 5 different Skystream serial numbers. For single turbine installations select letter “A” and enter the last seven digits of the turbine serial number. Use ⊙ and ⊙ keys to increase or decrease values and Enter ⊙ and Escape ⊙ keys to move from digit to digit. Data is saved when screen is exited using Enter ⊙ key.

**Wireless settings:**
This selection causes the WIRELESS MENU to be displayed. The WIRELESS MENU and each selection are described below:

After serial number(s) are entered use “Select Turbine” to choose which is to be monitored by remote display.

**WIRELESS MENU**

➜ Channel: 0 to 4
Mode: PASSIVE or ACTIVE
Extra Devices: Yes or No

**Channel:**
Enter a channel number from 0 to 4. Each number corresponds to a different radio frequency. There is no need to select a frequency other than the default frequency unless interference problems with other wireless devices are experienced or system is a battery charging system. In that case, the channel must be identical to the battery charging sensor. See battery charging section 3-5 Configuring Battery Sensor.

**Mode: PASSIVE or ACTIVE**
Select “Active” or “Passive” using the Enter ⊙ key. Selection is saved when Escape ⊙ key is depressed. Select “Active” when Remote Display is used to display data. Select “Passive” when logging data using USB converter and Datalogger Software.

**Extra Devices: Yes or No**
Select “Yes” or “No” using the Enter ⊙ key. Selection is saved when Escape ⊙ key is depressed. Select “Yes” if Battery Voltage Sensor is utilized or “No” if sensor is not utilized.

**TIP:** It is very IMPORTANT that YES is selected for battery charging system.

### 1-5 MONITOR TURBINE

Selecting “Monitor Turbine” from the main menu causes a list of Skystream operating information to be displayed as shown below:

Normal or Running or Regulate %
PWR: xxxxW xxxxxxxxWh
TMP: xxx.x RPM: xxx
BATT: xxx.x V

**Normal or Running (If Extra Devices is set to NO)**
Indicates Skystream power production status. “Normal” indicates normal operation but no power production. “Running” indicates Skystream is producing power.

**Regulate% (If Extra Devices is set to YES)**
Value approximates RPM. 100% corresponds to 325 RMP. Value will not go below 25% (80 RPM). At that speed, Skystream is producing very little if any power.

**PWR:**
Indicates instantaneous power production of Skystream in Watts and accumulated power in Watt-hours. Accumulated power is not activated at this time.

**TMP:**
Indicates ambient temperature as measured by Skystream. Temperature is displayed in Fahrenheit or Celsius depending on Units selection from SETTINGS MENU.

**RPM:**
Indicates rotational speed of Skystream blades in revolutions per minute.

**Batt:**
Displays Battery Voltage on systems with battery voltage sensor.

### 1-6 CONTROL TURBINE

Selecting “Control Turbine” causes the Control Menu to be displayed as depicted below.

**CONTROL MENU**
**Turbine On**
**Turbine Off**
➜ **Set Elevation**

Select a command using the ⓥ and ⓐ buttons and depressing the Enter ⓔ button. Each of the commands is described below.

**Turbine On**
The “Turbine On” command reverses the “Turbine Off” command. If Skystream has automatically shut down because of high wind or storm conditions the “Turbine On” command will not override the shut down condition.

**Turbine Off**
The “Turbine Off” command places Skystream in a “braked” condition. This is the same mode as though Skystream were disconnected from the utility grid.

**Warning:** Using the “Turbine Off” command does NOT turn off electrical power to Skystream. It is not safe to work on Skystream using only the turbine off command. When working on Skystream disconnect power at the utility disconnect switch or electrical panel.

**Set Elevation**
The “Set Elevation” command is used to configure Skysteam for operation at the installation elevation. Skystream is initially configured for operation up to 1000 meters (3,300 feet) above sea level. To adjust the elevation setting select “Set Elevation” from the Control Menu using the Enter ⓔ button. Input the elevation values using Enter ⓔ and ⓒ Escape buttons to select a digit and use the ⓥ and ⓐ buttons to increase or decrease the value. Enter the elevation value using the Enter ⓔ button.

**Indicator LED**
The indicator LED provides a quick visual indication of the Wireless Remote Display communication and Skystream power production status.

- Clear Illumination indicates communication with Skystream but no power is being generated.
- Green illumination indicates communication with Skystream and power production.
- Orange illumination indicates no communication with Skystream.

## 1-7 WIRELESS REMOTE DISPLAY

### 1-7-1 Contrast Adjustment

Contrast of the Wireless Remote Display may be adjusted via the Contrast Adjustment (see CONTROLS, page 3). Turn the adjustment clockwise to decrease contrast and counter clockwise to increase contrast.

### 1-7-2 Battery and AC Power

The Wireless Remote Display may be powered using either the rechargeable battery pack or AC power supply. The fully charged battery pack will sustain operation of the Wireless Remote Display for approximately 6 – 24 hours of continuous operation.

Because there is no On/Off switch on the Wireless Remote Display use of the AC Power adapter is strongly recommended.

To install batteries remove the battery cover on the back of the Wireless Remote Display by “unsnapping” the cover. A small screwdriver may be used to gently pry the slotted side of the cover from the main housing. Refer to the photograph at right and connect the batteries as indicated.

## 1-8 USB CONVERTER

The USB converter (shown at left) enables the Wireless Remote Display to import Skystream performance data to a personal computer for system monitoring, data analysis and diagnostic trouble shooting.

The USB converter includes the USB converter module and a USB cable to connect the module to a computer USB port. The user must purchase a CAT-5 ETHERNET cable to connect USB module to the Wireless Remote Display.

## TWO - Using Skystream DataLogger

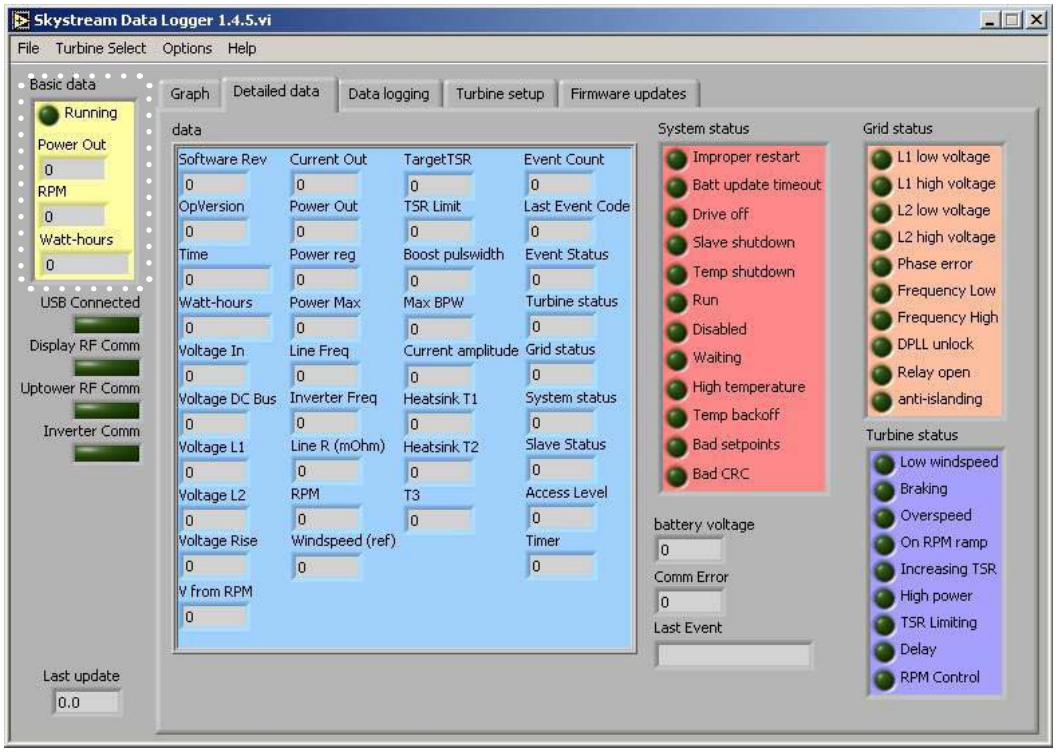
**TIP:** User must install Skystream DataLogger software before collecting data via the USB Converter. See page 19.

### 2-1 TO USE DATALOGGER:

- Power Wireless Remote Display (battery or AC adapter)
- Connect USB converter module to Wireless Remote Display with Ethernet cable. Also connect module to PC with USB cable.
- Open Skystream DataLogger program.

The main Datalogger display screen shown below should be displayed on PC.

Each indicator and selection available on the main display screen is described below.




### 2-2 BASIC DATA SCREEN

BASIC DATA – Located in the upper left corner of the display.

- Running – when illuminated indicates Skystream is operational
- Power Out – displays instantaneous Skystream power output in Watts
- RPM – displays instantaneous Skystream blade rotation speed in revolutions per minute
- Grid Voltage – displays the electric utility grid voltage as measured by Skystream
- Watt-hours – displays accumulated Watt-hours. For example if Skystream produces 800 watts for an hour display reads 800 Watt-hours.

LAST UPDATE – Text box located in lower left corner of display

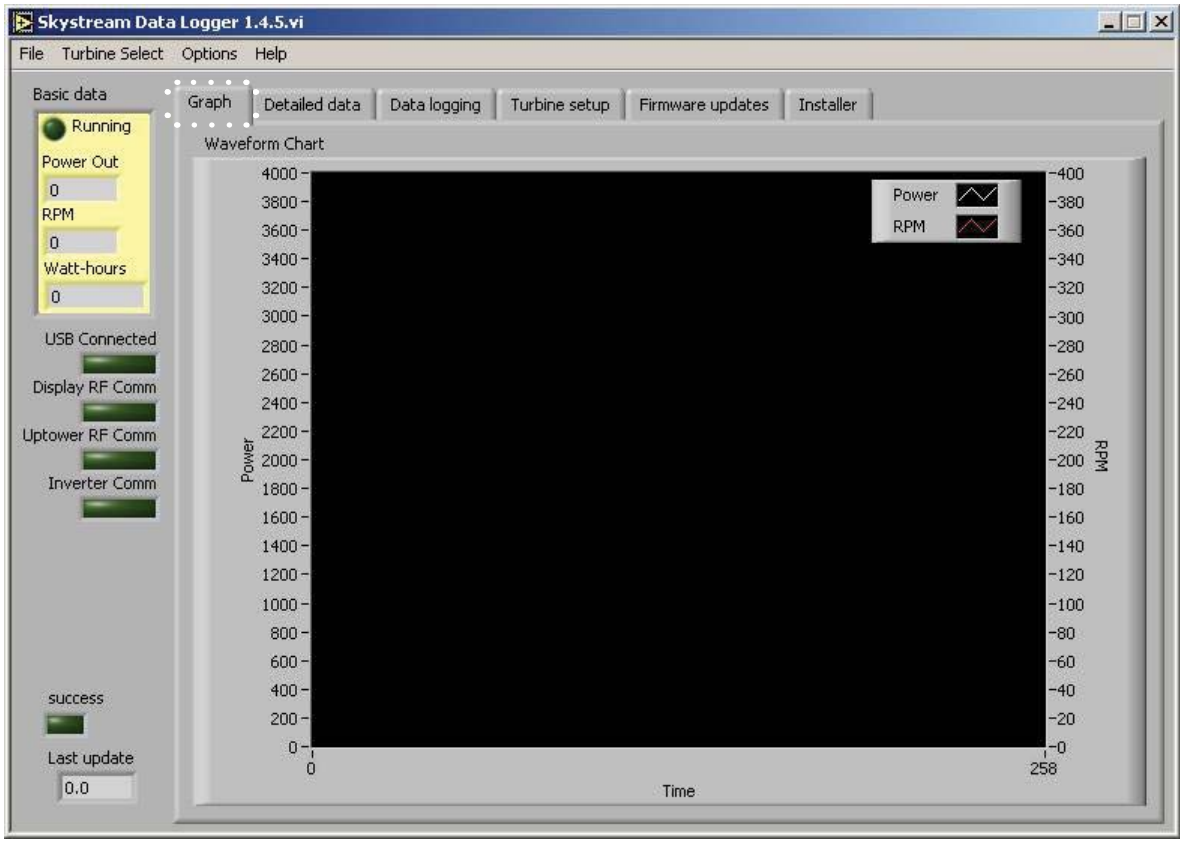
- Displays communication time in seconds between Remote Display and Skystream. Short communication time (0.2 – 0.3 seconds) indicates stable communications.

### 2-3 SELECTION TABS

There are six selectable tabs entitled Graph, Detailed Data, Data Logging, Turbine Setup, Firmware Updates, and Installer. Each tab is discussed separately in the following sections.

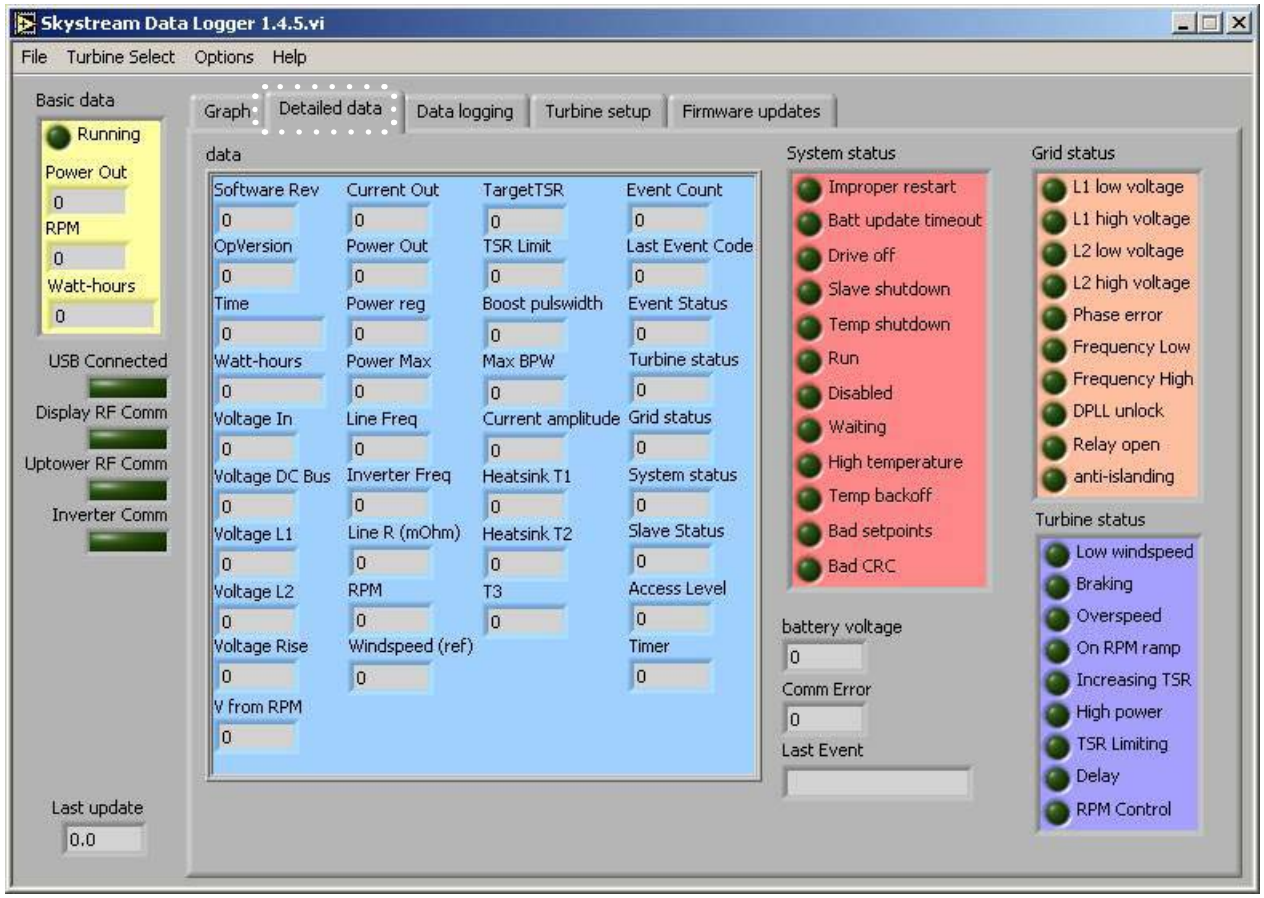
#### 2-3-1 GRAPH

The screen below is displayed by selecting the Graph tab. It will display collected Power and RPM data as shown.



### 2-3-2 DETAILED DATA

The screen below is displayed by selecting the Detailed Data tab. Much of the information presented on the Detailed Data screen may be of little interest to the casual user. However, it may be helpful in diagnosing or trouble shooting therefore it is provided to assist with service and maintenance.



### 2-3-3 DATA LOGGING

The Data Logging screen shown on page 13 is presented as a result of selecting the Data Logging tab.

**Logging Data**

**To start logging data:**

- Set Wireless Remote Display to “Passive” mode. Mode selection is available from MAIN MENU > Device Settings > Wireless Settings > Mode.
- Select the Data Logging tab from the main display screen.
- Select or create a folder where the data files will be stored by clicking on the folder icon next to the text box titled “Folder for log files” As log files are created DataLogger will place the files in this folder. It may be most convenient to create folder on computer Desktop.
- Set the sample interval in seconds in the text box labeled “Write to file every _____second.” If “0” is entered in the text box data will be written to the file as soon as data is available from Skystream. This may be multiple times a second.
- Create the file name and format. The file name and format controls the size of the file and how often a new data file is placed in the Log File Folder created previously. See “Creating File Names, File Format” below.
- Select “Start auto logging” to start collecting data.

**To end logging data:**

- Depress oval shaped “Start auto logging” button on data logging screen a second time to stop data logging. Green “light” on switch will turn off.

**Creating File Names, File Format**

A new file is created and the old file moved to the file Folder specified on the Data Logging page. A new file is created on a time basis using special characters in the file name. The special characters and associated time intervals are listed below.

**%Y** = Year **%H** = hour **%m** = Month **%M** = minute **%d** = day

For example if the file string is specified as “Skystream%H” a new file is created every hour since the smallest time interval character is %H – an hour. The time interval is based on the PC clock running the DataLogger software. Also be aware that in the above case only 24 files will be created since the first file will be appended (data will be added to end of file) the next day at the same hour. For this reason it is recommended to use the complete YearMonthDay_Hour code in most cases.

File sizes are not limited. If a time interval of a year is selected and the sample rate is set to one second expect a very large file. Data is stored as comma separated data and is readily imported into spreadsheet programs such as Excel for analysis.

### 2-3-4 TURBINE SETUP

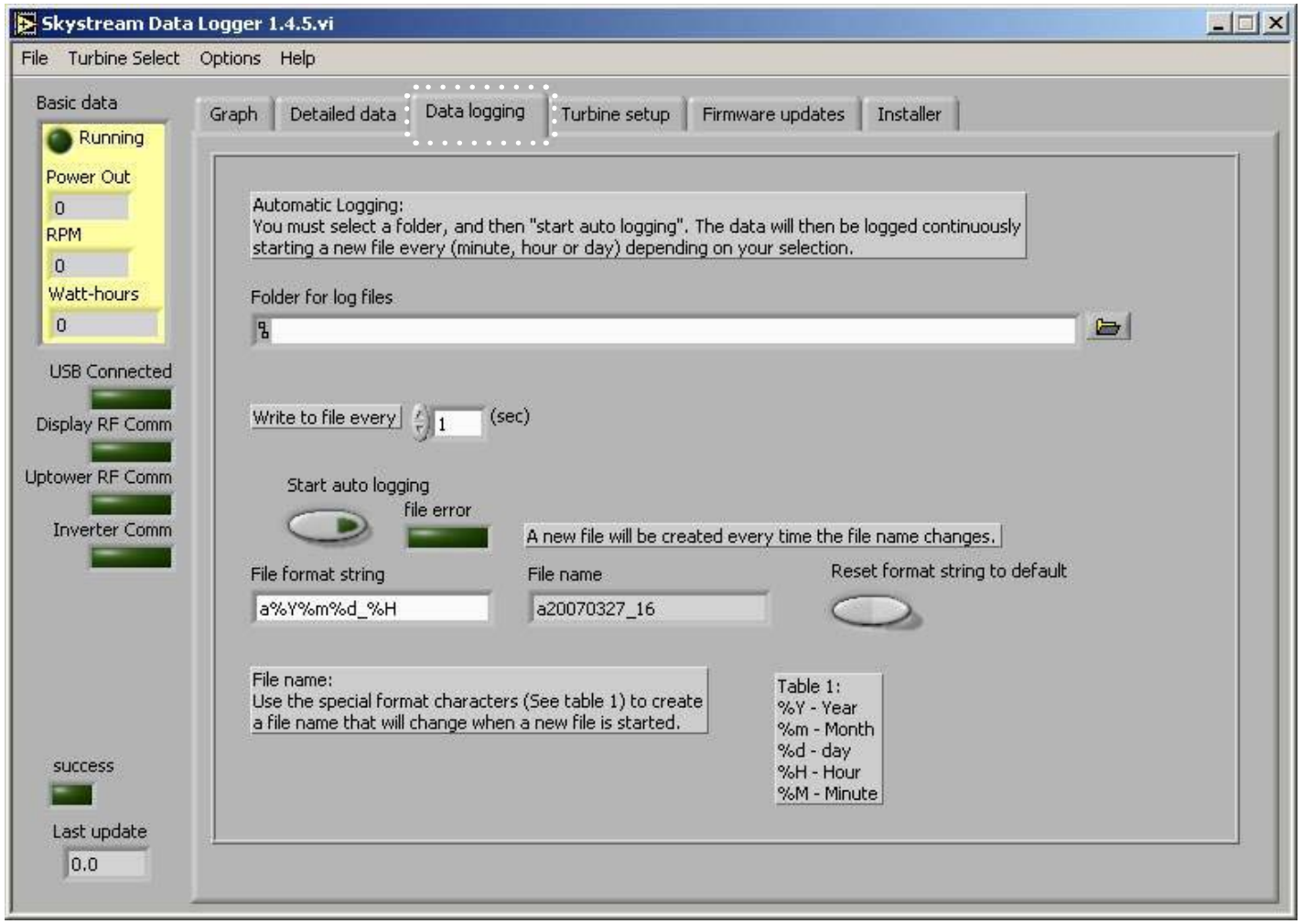
Use of the Turbine Setup Screen is described in detail in Section THREE - Setting up for Battery Charging.

### 2-3-5 FIRMWARE UPDATES

The Firmware Update Screen may be utilized to update inverter, RF Communications, Battery Sensor or Remote Display software. If a software update is required specific instructions will be provided with the update.

### 2-3-6 INSTALLER

Use of the Installer Screen is described in detail in Section THREE - Setting Up for Battery Charging.




Data Logging Screen

## THREE - Setting Up for Battery Charging

### 3-1 INTRODUCTION

Skystream is easy to adapt for battery charging systems or battery-backed grid connected installations. To operate correctly, however, requires configuring each turbine in the system and the battery voltage sensor using the DataLogger Software. The Wireless Remote Display – if equipped must also be set up for battery charging. Setting up for battery charging consists of four basic steps:

- Entering turbine serial numbers into DataLogger Software
- Configuring Battery Voltage Sensor
- Configuring turbines for battery charging.
- Configuring Wireless Remote Display (if equipped)

### 3-2 BATTERY VOLTAGE SENSOR INSTALLATION

The Battery Voltage Sensor is shown on page 22. Customer is required to supply two battery connection terminals and color coded wire.

Install sensor as follows:

- The battery voltage sensor connector will accept #20 to #14 AWG wire. Use largest gauge wire compatible with battery connection terminals. Follow good practice and color code wires – red for positive, black for negative is typical.
- Determine sensor mounting location, maximum recommended wire length is 150 ft and 30 ft for #14 and #20 AWG wire respectively.
- Strip approximately 1/4" of insulation from wires and insert in green connector supplied with Battery Voltage Sensor. Tighten screws to secure wires. Correct wire locations (battery + and -) are indicated on Battery Voltage Sensor cover. Refer to Fig. 9
- Strip insulation from other end of wires ends and install battery connection terminals following manufacturer's recommended procedure. Connect battery connection terminals to batteries.
- Insert green connector into Battery Voltage Sensor.

The sensor is now powered and ready for configuration with your system. Do not leave sensor connected to batteries without configuring sensor and Skystream for battery charging.

**IMPORTANT:** Battery Voltage Sensor and Skystream must be configured for battery charging or serious damage to batteries may result.

### 3-3 REQUIREMENTS

Setting up a battery charging system requires:

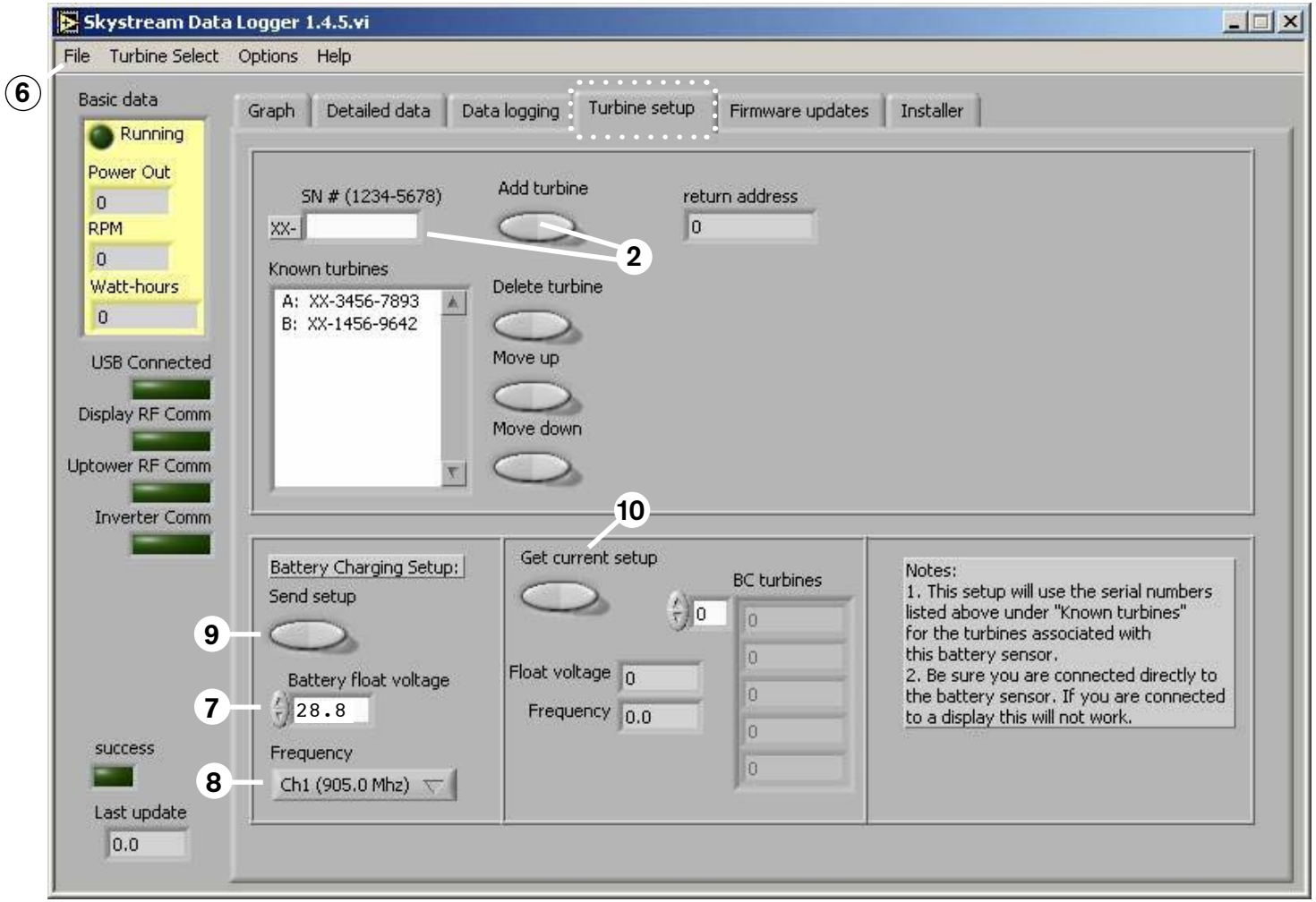
- PC or laptop with DataLogger Software installed. (version 1.4.5 or greater).
- USB converter, cat 5 ethernet cable, USB adapter cable, DO NOT CONNECT WIRELESS REMOTE DISPLAY TO PC.
- Installed Battery Voltage Sensor, sensor must be powered during configuration. See 3-2 Battery Voltage Sensor Installation.
- Skystream 3.7 installed according to recommended battery charging options shown in Section 2 of Skystream manual.

### 3-4 ENTERING SERIAL NUMBERS INTO DATALOGGER SOFTWARE

Perform following steps to enter turbine serial numbers into DataLogger Software. The "Turbine Setup" screen is shown on page 15. Buttons or areas of the screen referenced in the instruction are indicated with the instruction number.

1. Start DataLogger software and go to Turbine setup screen as shown on page 15.
2. Enter the turbine serial number in the "SN# (1234-5678)" text box and depress "Add turbine" button. This enters the serial number in DataLogger software. (leading digit defaults to 1)
3. If there is more than one Skystream in the system enter the serial number of each turbine. Verify serial numbers are entered correctly.

*continued on pages 15-16*



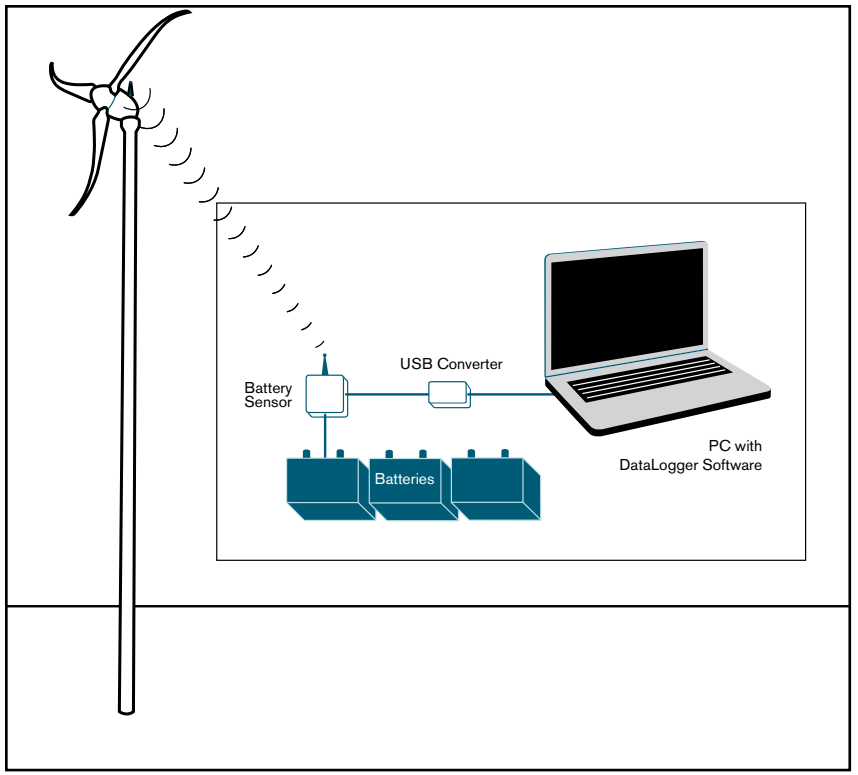
Turbine Setup Screen

### 3-5 CONFIGURING THE BATTERY SENSOR

4. Connect the Battery Voltage Sensor to PC or laptop (with DataLogger software). Use ethernet cable, USB cable and USB converter as shown at right.
5. Connect Battery Voltage Sensor to batteries, the sensor MUST be powered during update - refer to sensor installation instructions.
6. Select “Enable Advanced Settings” from “File” pull down menu in upper left hand corner of screen. This will cause “Installer” tab to be displayed. Do not go to Installer screen yet - remain on Turbine setup screen.
7. Enter the system “float voltage” text box in the “Battery float voltage” text box. Float voltage is defined as the system voltage when there is no current draw. Southwest Windpower recommends the following float voltage settings:

| System Voltage | Float Voltage Setting |
|---|---|
| 12 volts | 14.1 volts |
| 24 volts | 28.2 volts |
| 36 volts | 42.3 volts |
| 48 volts | 56.4 volts |

8. Select the communication channel number from the pull down menu labeled “Frequency”. This will be the communication frequency of the battery charging system.
9. Depress the “Send setup” button. This sends the float voltage, the selected frequency and the turbine serial numbers listed in the “Known turbines” test box to the Battery Voltage Sensor. Make sure the numbers are correct and all turbines are listed. If communication is successful the “success” light at the bottom of the screen will turn green.
10. At any time, Battery Voltage Sensor settings may be viewed by depressing the “Get current settings” button. “success” light at the bottom of the screen must turn green and sensor information is under “Get current setup” button.

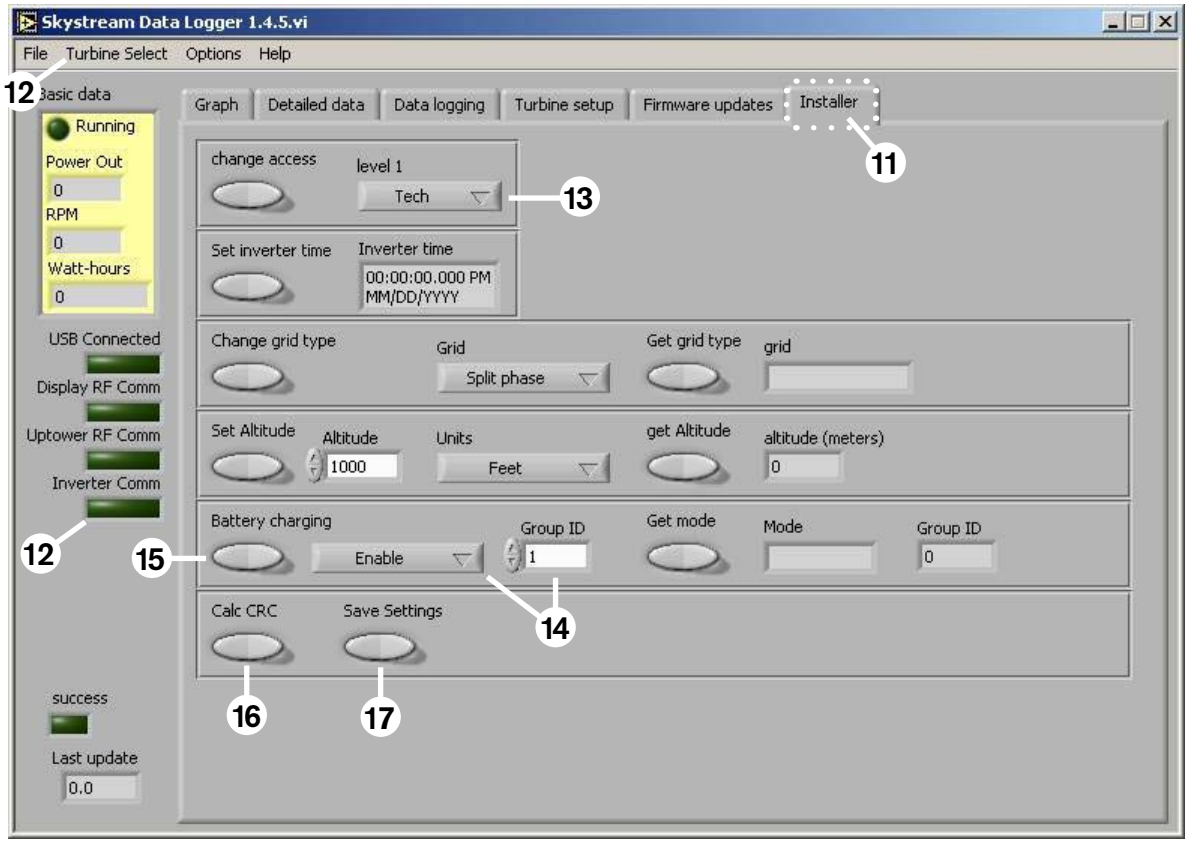



Information flow for battery charging configuration.

**Warning:** Incorrectly setting float voltage may cause battery over-charge and damage.

### 3-6 CONFIGURING TURBINE(S) FOR BATTERY CHARGING.

11. Select “Installer” screen shown at right by clicking on Installer tab.
12. Select the turbine from the “Turbine Select ” pull down menu at the top of the screen (see above). Observe “Inverter Comm” light illuminate when communication occurs (see below).
13. Set access level to “Tech” from pull down menu from “change access” field as shown above. Depress “change access” button after “Tech” is selected. Success will be indicated by the “success” light turning green.
14. Set “Battery charging” to “Enable” as shown above. Enter “1” in the text box labeled “Group ID”. This value MUST be set “1”.
15. Depress “Battery Charging” button to upload settings to Skystream. Successful transmission will be indicated by illumination of the “success” light.
16. Depress the “Calc CRC” button at the bottom of the page. Success is indicated by illumination of the “success” light.
17. Depress the “Save Settings” button, success will be indicated by illumination of the “success” light.
18. Repeat steps 9 through 15 for remainder of turbines from the “Turbine Select” pull down menu.



Installer Screen

**IMPORTANT:** “Battery charging” MUST be set to “ENABLE” or serious damage to batteries may result.

### 3-7 CONFIGURING WIRLESS REMOTE DISPLAY

If battery charging system is equipped with the optional Wireless Remote Display, the display must be configured to operate correctly with the Battery Voltage Sensor.

To configure the Wireless Remote Display perform the following steps:

1. Enter the turbine serial number(s).
   MAIN MENU >
   Device Settings >
   Select Turbine. Enter the serial number and depress ⊙ Enter key.

2. Enter the channel number (0 to 4).
   MAIN MENU >
   Device Settings >
   Wireless settings > RF MENU > Channel. Enter the same channel number as the Battery Voltage Sensor – see Section 3 -5, step 8.

3. Set “Extra Devices” to “YES”.
   MAIN MENU >
   Device Settings >
   Wireless settings >
   RF MENU > Extra Devices. Toggle between “YES” and “NO” using the ⊙ Enter key and save setting using the ⊙ Escape key.

**IMPORTANT:** The channel selected on the remote display must be the same channel selected on the battery sensor.

## FOUR - Skystream DataLogger Installation Instructions

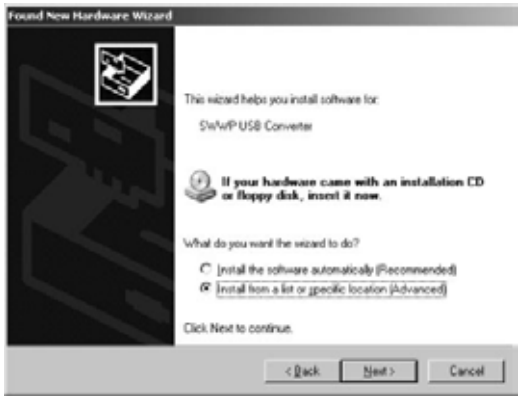
### 4-1 INSTALL THE USB DRIVERS

1. Attach the USB converter to the computer's USB port using the black USB cable provided.

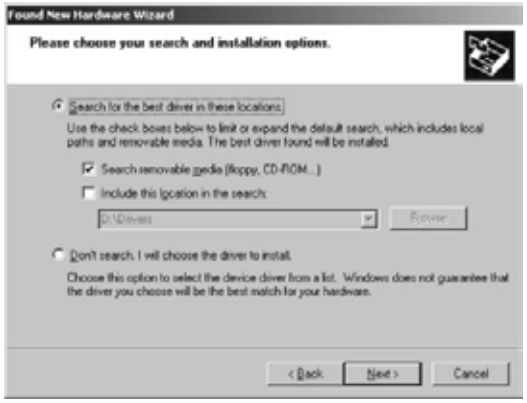
2. Insert the CD "Skystream Datalogger and USB Converter" into the CD drive of your desktop or laptop PC. PC must have Windows 2000 or Windows XP operating system. Find and open the file "Quick Start Guide" and follow the instructions to install the Skystream DataLogger program and USB converter. The instructions. The Quick Start Guide follows:

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).
Read our privacy policy
Can Windows connect to Windows Update to search for software?
Yes, this time only
Yes, now and every time I connect a device
No, not this time
Click Next to continue.
< Back
Next >
Cancel

3. Choose "No, not this time" on the first screen of the "Hardware Wizard."


Found New Hardware Wizard
This wizard helps you install software for:
SWWP USB Converter
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

4. Choose "Install from a list or specific location."


Found New Hardware Wizard
Please choose your search and installation options.
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable media (floppy, CD-ROM...)
Include this location in the search:
D:\Drivers
Browse
Don't search. I will choose the driver to install.
Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< Back
Next >
Cancel

5. The drivers are located in the "Drivers" folder on the CD-ROM. If you choose "Search removable media" Windows should find the drivers.

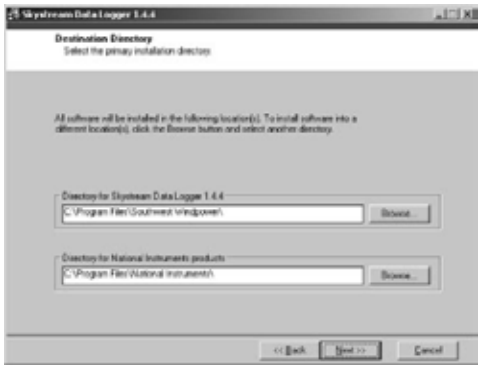
Hardware Installation
The software you are installing for this hardware:
SWWP USB Converter
has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation

6. Click "Continue Anyway".

7. You will be prompted to install another driver. Repeat steps 3 through 6

## 4-2 INSTALL SKYSTREAM DATALOGGER

1. Run the file “setup.exe” included on this CD-ROM.
2. Choose the folder you want to install the software to. You will see the following screens during the installation process:


Destination Directory
Select the primary installation directory
All software will be installed in the following location(s). To install software into a different location(s), click the Browse button and select another directory.
Directory for Skystream Data Logger 1.4.4:
C:\Program Files\Southwest Windpower\
Browse...
Directory for National Instruments products:
C:\Program Files\National Instruments\
Browse...
<< Back
Next >>
Cancel

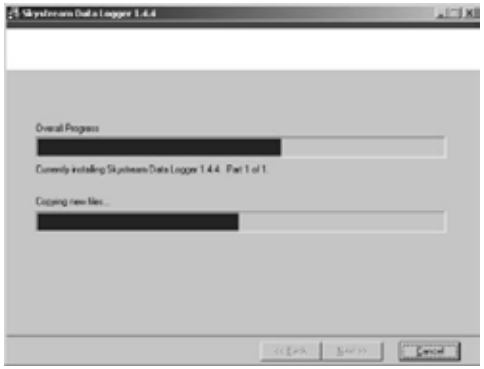
3. Change directory if needed. Click “Next”.

License Agreement
You must accept the license(s) displayed below to proceed.
NATIONAL INSTRUMENTS SOFTWARE LICENSE AGREEMENT
I accept the License Agreement(s).
I do not accept the License Agreement(s).
<< Back
Next >>
Cancel

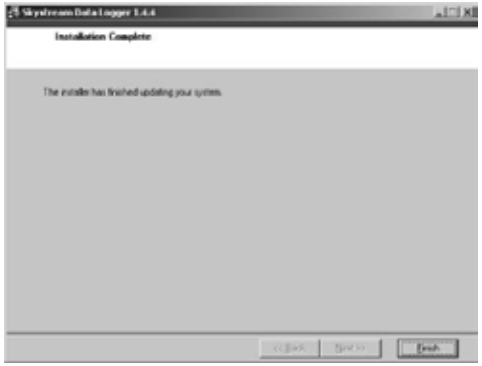
4. “Accept” the License Agreement.

Start Installation
Review the following summary before continuing.
Adding or Changing
Click the Next button to begin installation. Click the Back button to change the installation settings.
Save File...
<< Back
Next >>
Cancel

5. Verify the version.




6. No action required.



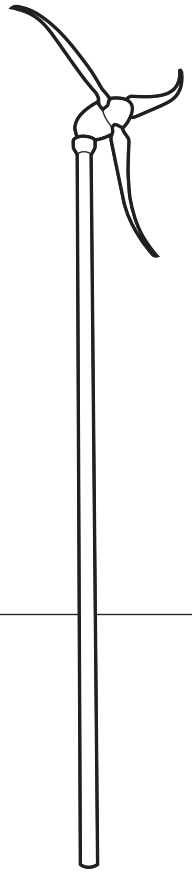

7. Click “Finish”.

## 4-3 RUN DATALOGGER

8. Now that the software is installed you can run “Skystream Data Logger” from
   Start >
      Program Files >
         Southwest Windpower >
            Skystream Data Logger

SKYSTREAM 3.7™

# APPENDIX E
# CERTIFICATION/ COMPLIANCE



Skystream 3.7, Land, 230V, 50Hz, 1Ph (Item# 1-SS
Skystream 3.7, Marine, 230V, 50Hz, 1Ph (Item# 1-

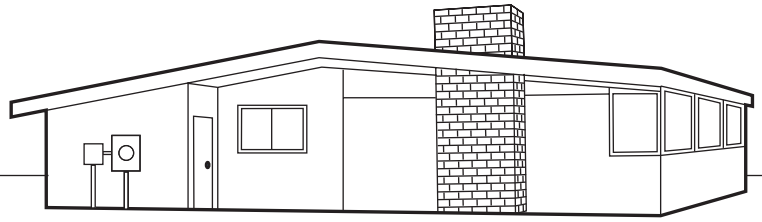
eclare that Skystream 3.7 small wind turbine meets the esse
ements by design and construction as follows:

mply with the Machinery Directive 98/37/EC.
mply with the small wind turbine design standard IEC 61400

mply with Directive 2005/88/EC for noise limits and labeling
we comply to all safety aspects of the Low Voltage Directive
s certified in USA to comprehensive safety standards UL174

mply to the R&TTE directive 99/5/EC and will have undergo
sting by Underwriters Laboratories to document conformity b

y comply to the EMC directive 2004/108/EC by August 1, 20
% compliant to RoHS directive 2002/95/EC and will fully com



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1801 West Route 66
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**www.skystreamenergy.com**

MADE IN THE USA

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# Certificate of Compliance

Certificate Number **20071402E300731**
Report Reference **E300731, Issued 2006-10-17**
Issue Date **2007 February 14**



Underwriters Laboratories Inc.®

*Issued to:*

## Southwest Windpower Inc

1801 W Rte 66
Flagstaff, AZ 86001
United States

*This is to certify that representative samples of*

## Skystream Inverter

Component inverter for use with Skystream wind turbine, Utility Interactive Ready

***Have been investigated by Underwriters Laboratories Inc.® in accordance with the Standard(s) indicated on this Certificate.***

*Standard(s) for Safety:*

UL 1741, Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, 1st Ed.; IEEE 1547-2003; CAN/CSA-C22.2 No.107.1-01, 3rd Ed., General Use Power Supplies

*Additional Information:*

Output configuration: 120/240V, L-N-L, Oper. voltage range Vac: 212-264; or 120/208V, L-N-L, Oper. voltage range Vac: 183-229; Normal out frequency Hz: 60.0; Operating frequency range Hz: 59.3-60.5; Rated output current Aac: 10.0; Rated continuous output power kW@25 °C: 1.8; Rated continuous output power kW@50°C: 1.4; Max. peak output kW: 2.4; Surge Rating B3

Only those products bearing the UL Recognized Component Marks for the U.S. and Canada should be considered as being covered by UL's Recognition and Follow-Up Service and meeting the appropriate U.S. and Canadian requirements.

The UL Recognized Component Mark for the U.S. generally consists of the manufacturer's identification and catalog number, model number or other product designation as specified under "Marking" for the particular Recognition as published in the appropriate UL Directory. As a supplementary means of identifying products that have been produced under UL's Component Recognition Program, UL's Recognized Component Mark: , may be used in conjuction with the required Recognized Marks. The Recognized Component Mark is required when specified in the UL Directory preceeding the recognitions or under "Markings" for the individual recognitions. The UL Recognized Component Mark for Canada consists of the UL Recognized Mark for Canada: and the manufacturer's identification and catalog number, model number or other product designation as specified under "Marking" for the particular Recognition as published in the appropriate UL Directory.

**Look for the UL Recognized Component Mark on the product**

Issued by: Chris Storbeck
**Chris Storbeck, Project Engineer**
Underwriters Laboratories Inc.

Reviewed by: ChristopheFlueckiger
**Christopher Flueckiger, Sr. Project Engineer**
Underwriters Laboratories Inc.

Any information and documentation involving UL Mark services are provided on behalf of Underwriters Laboratories Inc. (UL) or any authorized licensee of UL. For questions in The United States of America you may call 1-877-UL-HELPS.

# Declaration of Conformity

SKYSTREAM 3.7
1.8 kW residential power appliance

For battery charging applications only

**Product:** **Skystream 3.7**

Type: Skystream 3.7, Land, 230V, 50Hz, 1Ph (Item# 1-SSL-11-230)
Skystream 3.7, Marine, 230V, 50Hz, 1Ph (Item# 1-SSM-11-230)

We hereby declare that Skystream 3.7 small wind turbine meets the essential European Union requirements by design and construction as follows:

- We fully comply with the Machinery Directive 98/37/EC.
- We fully comply with the small wind turbine design standard IEC 61400-2.

- We fully comply with Directive 2005/88/EC for noise limits and labeling requirements.
- We believe we comply to all safety aspects of the Low Voltage Directive 2006/95/EC as this product is certified in USA to comprehensive safety standards UL1741 / IEEE 1547.

- We fully comply to the R&TTE directive 99/5/EC and will have undergone the necessary testing by Underwriters Laboratories to document conformity by July 1, 2007.

- We will fully comply to the EMC directive 2004/108/EC by August 1, 2007.
- We are 99% compliant to RoHS directive 2002/95/EC and will fully comply by July 1, 2007.

Based on the above indicated conformance, we are applying the CE-mark to the above models for export to Europe.

Remark:
The above CE compliance will be invalidated if:

- The machine is modified in any way without the explicit written consent of Southwest Windpower.
- The machine is used or connected in a manner or configuration that Southwest Windpower does not regard as its intended application.

Dated, April 5, 2007

David Calley
(President and Chief Technology Officer, Southwest Windpower)

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SKYSTREAM 3.7™

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